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ABSTRACT

The two-track system that divides academic education from vocational education no longer supports students' interests. This book describes a practical approach to integrating academic and vocational education, focusing on achieving a seamlessly integrated curriculum. Chapter 1 describes the rationale of a high school program--the Cocoa Academy for Aerospace Technology (CAAT) in Brevard County, Florida--that combines aerospace technology with traditional education. Chapter 2 discusses the role of technology in education and CAAT's use of technology-learning activities (TLAs), which are hands-on, interdisciplinary, problem-solving activities. Movement toward CAAT's system of learning, called "virtual learning," is described in chapter 3. In virtual learning, students and facilitators teach each other how to learn; the curriculum blends a range of disciplines; students learn in teams; facilitators teach in teams; all problem-solving activities have real-world relevancy; and authentic assessment is used to evaluate learning objectives. Examples of virtual-learning activities are provided in the fourth chapter. Chapters 5 through 8 describe the process for developing a curriculum framework and learning objectives, the steps for writing virtual-learning activities, and ways to sustain the program. The final chapter concludes that the integrated academic-vocational curriculum is central to democracy in public schools. A glossary and 11 figures are included. (Contains 35 references.) (LMI)

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INTEGRATING ACADEMIC VOCATIONAL EDUCATION

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INTRODUCTION

Across the United States, business leaders, policymakers, parents, and educators are calling for changes in our schools. Among the most vociferously argued of the proposed changes is the integration of vocational and academic education. Many believe this change is essential if we want high school graduates to be prepared to meet the challenges they will face in the workplace and in postsecondary education.

Our world has changed since the advent of public education in the United States, with its early and continuing division between the academic and vocational areas. This two-track system no longer supports people's best interests—if, indeed, it ever did. Despite research showing the benefits of integrated studies, despite legislative mandates and monetary incentives, and despite the common sense of such an education, few schools have merged academic and vocational education or even been willing to give each its equal worth.

The very institutions that promote the integration of academic and vocational education (i.e., federal, state, and local school agencies) still have separate organizational divisions for each area, with the vocational education department usually taking a backseat to the academic. Too many people hold to the original ideals of the common school—that all children should receive the same education in exactly the same way and that to be educated is to be book-learned.

In this book, we describe a practical approach to integrating academic and vocational education, focusing not only on the mechanics of integrating curriculums, but also on the factors that conspire to keep academic and vocational education separate and unequal.

Although there are a number of models for integrating academic and vocational education and a range of levels at which integration may take place, the model in this book focuses on achieving a seamlessly integrated curriculum. The examples and

procedures are drawn from experience; they are methods that really work. And a foundation of educational research and pedagogy supports the process, which is designed to create a framework for the seamless integration of academic and vocational curriculums. Each learning community can customize this model to its specific needs and limitations.

Far more has been said and written about the integration of academic and vocational curriculums than has been done to achieve it. Abstract theories and impractical methods, however, do not aid curriculum integration efforts. In this book, we hope to act as both the idealistic pathfinder and the practical guide to turning theory into reality.

1

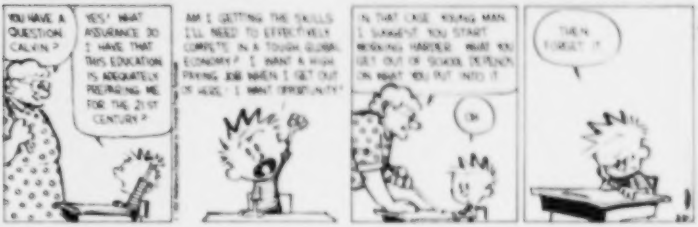
RESPONDING TO THE DEMAND FOR RELEVANCY

For years educators have attempted to satisfactorily answer students' questions about the relevancy of their curriculum: "What does this have to do with the real world?" "Am I ever going to use this stuff?" "Why can't we do something interesting?" Finding satisfactory answers to these somewhat rhetorical questions has been difficult, for although more than half of all students will never go to a four-year college, many are being pushed through the same academic curriculum (or, typically, a watered-down version of it) as their university-bound classmates.

When asked, most high school students say they want to go to college; however, few can explain why or even what they must do to be accepted by a college. Others contemplate military service in order to buy more time, to make career decisions, and to receive training. Still others "just don't know." It is the rare student who has well-defined career goals and clear strategies for achieving them. In short, although students justifiably question the relevancy of their curriculum, many cannot identify "real-world" applications or delineate career goals.

Some students are savvy enough to recognize that they need an education that keeps pace with the changing world. In the cartoon on the next page, Calvin initially appears to be a con-

Calvin and Hobbes **by Bill Watterson**


YOU HAVE A QUESTION, CALVIN?
YES! WHAT ASSURANCE DO I HAVE THAT THIS EDUCATION IS ADEQUATELY PREPARING ME FOR THE 21ST CENTURY?
AM I GETTING THE SKILLS I'LL NEED TO EFFECTIVELY COMPETE IN A TOUGH GLOBAL ECONOMY? I WANT A HIGH PAYING JOB WHEN I GET OUT OF HERE! I WANT OPPORTUNITY!
IN THAT CASE, YOUNG MAN, I SUGGEST YOU START WORKING HARDER! WHAT YOU GET OUT OF SCHOOL DEPENDS ON WHAT YOU PUT INTO IT.
OH
THEN FORGET IT.

CALVIN AND HOBBES © 1992 Watterson. Dist. by UNIVERSAL PRESS SYNDICATE. Reprinted with permission. All rights reserved.

cerned, empowered student who recognizes the need to be prepared for the 21st century. When the teacher tells Calvin to work harder, however, we see the real, disgruntled Calvin. Calvin's response—"Forget it"—raises an important question: *Is working harder at what has not proven successful really the answer?*

The writers of what is commonly called the SCANS report (U.S. Department of Labor 1991) set out to answer a related question: What does work require of schools? They found that "good jobs depend on people who can put knowledge to work" (p. v). The report goes on to say that "the most effective way of learning skills is in context, placing learning goals within a real environment rather than insisting that students first learn in the abstract what they will be expected to apply" (p. xv).

Clearly, the challenge to educators is twofold. Educators must assist students in developing educational and career goals, and they must ensure that the educational environment will enable students to meet those goals. In high schools, some educators are meeting this challenge by integrating academic and vocational/technical curricula.

The Setting

Cocoa High School is a comprehensive secondary school for grades 9–12 built in 1968 on 67 acres of land in Brevard County, Florida. In 1993, in response to overwhelming evidence that its high school graduates did not have the skills needed to continue their education and to successfully compete in today's high-tech work force, educators at Cocoa High created a school-to-work

transition program for students in grades 10–12. A grant from the Florida Department of Education to form "Academies of Applied Technology" provided the funds needed to get the program off the ground. Because Brevard County is home to the Kennedy Space Center, NASA, and major aerospace corporations, it made sense for the program to become a career academy with a focus on aerospace technology. Hence, in the campus-like traditional education setting of this high school lies the Cocoa Academy for Aerospace Technology (CAAT).

More like a research and development lab than a classroom, CAAT's uniqueness is exemplified in five ways:

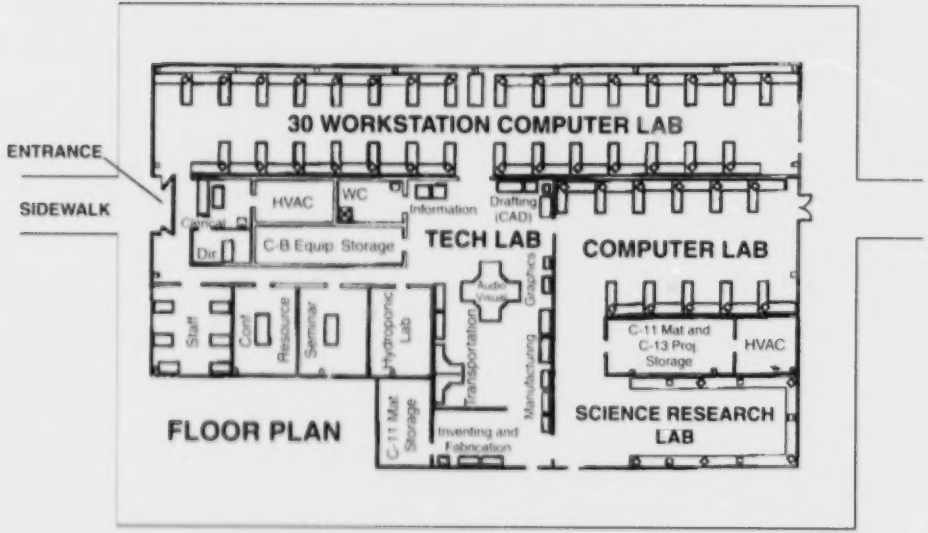
- Its commitment to the integration of academic and vocational learning.
- Its success in using relevancy to motivate students to stay in school.
- Its pledge to link work and learning by nurturing partnerships with the aerospace industry.
- Its use of hands-on technology to improve students' prospects for employment that will lead to a career.
- Its simulation of the corporate workplace through the use of hardware and software tools that are standard in the aerospace industry.

CAAT's 13,000-square-foot building houses two large computer labs that serve as the main instructional and group-work areas, a science lab, a hydroponics lab, a production lab, a technology lab, a seminar room, a resource room, and work areas for staff (see the floor plan in Figure 1.1). The computer labs are outfitted with powerful computers (486-model PCs, 33mhz, 16MB RAM, 220 MB hard drive). All computers and peripherals are connected by a peer-to-peer network system called Windows for Workgroups. The computers are also connected to the Internet. All the computer software applications meet industry standards.

The Students

The student profile of CAAT mirrors that of the larger school and community: approximately 70 percent white, 30 percent African American, and 5 percent other minorities, including Hispanic, Asian, and Native American. Although technology programs traditionally attract more boys than girls, CAAT has enjoyed gender equity. The 25 percent indigence statistic of Cocoa High's student body is the same for CAAT.

Figure 1.1
CAAT Floor Plan



Although most CAAT students are from the Cocoa High area, students are recruited from all over Brevard County. Criteria for selection to CAAT are straightforward: 9th grade students may apply to CAAT during their spring semester and be considered if (a) they are willing to work in teams, (b) they are willing to stay with the program through graduation, (c) they obtain two recommendations and permission from their parents, and (d) they write a short essay expressing why they wish to be considered for CAAT.

Approximately twice as many eligible students apply as can be enrolled. Due to space constraints, CAAT is limited to 225 students. Therefore, once students meet the above criteria, they are then randomly selected for the program. In this way, students of all abilities are given a fair chance of being admitted. CAAT's recruitment methods and policy of random selection have contributed to its equitable demographic distribution.

The Philosophy

For thousands of years people have learned in the "real world." We learned to fish in oceans and streams; we learned to build igloos in the snow; we learned to plant in the fields; we even learned assembly-line work in factories. Over the last 100 years, however, we have created artificial environments in which people are supposed to do the bulk of their learning.

Unlike the Native American papoose who spent the day on her mother's back, learning about the world from her mother's daily behavior, children all over the world now sit in rows divided by artificial barriers such as discrete academic disciplines and instructors, chalk-and-talk instruction, Carnegie units, 50-minute periods, and more. Michael Roberts, vice president of Educom, reminds us that "it is only in the last 150 years that we have gotten stuck in this rote model where if it's not in a classroom with a faculty member talking at you, it's not eligible for credit" (Ubois 1995, p. 84).

Although this learning environment has served us for a short period of time (assembly-line education in the Industrial Age), it is ill-suited to the Information Age. We must remove barriers and offer students a learning environment that better prepares them for the world they will be living in. Virtual Learning,* the model

*Virtual Learning is a service mark of the Cocoa Academy for Aerospace Technology.

employed by CAAT, removes the artificial barriers of education, leading ultimately to integrated subjects.

Although Virtual Learning does not provide the natural learning environment of the Native American baby, it does provide an environment that simulates, as closely as possible, the world that students will enter after graduation. Such an environment encourages students, both individually and in teams, to focus on the process of solving problems in context instead of completing isolated tasks. It allows them to come up with practical solutions instead of simply completing assignments. To better understand just how this philosophy works, let's look in on a CAAT student during the course of his day.

A Typical Day

John, an Academy student, arrives at 7:05 a.m. and places his books and personal items on the shelf above the computer workstation he shares with four other students. He then logs onto the computer and opens the word-processing document in which he keeps his daily journal.

John is an 11th grade student for which CAAT was a last-ditch effort at both staying in school and learning. The previous school year (prior to enrolling in the Academy), John was absent more days than he was present, and on the days he showed up he was usually serving in-school suspension. His school counselor and parents encouraged him to apply to the Academy, despite his .4 GPA, because they felt that a nontraditional, hands-on approach to learning, where technology was a major focus, might be just the thing to turn John around and enable him to finally experience some success in school.

Within the first 15 minutes of each day John completes his daily journal entry. That is his scheduled time for using the computer for journal writing. His teammates are scheduled to do their journals at different times during the day, so there is seldom a conflict. At 7:30, John and his teammates open their daily planning notebooks in preparation for the day's briefing.

Each morning the students receive a 15- to 20-minute briefing from their teacher informing them of the day's objectives and of any special scheduling (e.g., guest speakers or special training classes). On some days a new problem-solving activity is introduced and the briefing lasts longer. For instance, the teacher may introduce an activity on the topic of solar energy that requires students to design, produce, and market a solar-powered device.

Students are typically given several days to complete a project of this nature.

Although John knew that the Academy was going to be a different kind of school, when he began the program he was surprised that there were no bells to end one period and begin the next, that there were no separate classrooms or subjects where teachers stood up and talked the whole time, and—most of all—that teachers did not tell students exactly what to do and when to do it. Students have a lot of freedom but also a lot of responsibility. Although John gets to do a lot of talking and moving about during the day, he is also required to do a lot of thinking. He has to budget his time and get along with his team members, and they must all agree on what to do and when to do it.

After the briefing, John and his team members meet for a brainstorming and time management session. They outline their responsibilities for the project at hand and delineate who will do what and when. New projects require longer brainstorming sessions, and John must come to consensus with his teammates about how to solve problems posed by the new projects. John is part of a team of five students, and this team is part of a division of five teams for which a teacher/facilitator is responsible. Each team is heterogeneously grouped. For example, John's four teammates are of varying abilities and grade levels. Clarisa, who is the math whiz in the group, is a 10th grader and has a 3.5 GPA. Ben, a 12th grade football star who came into the Academy with a 2.0 GPA and brought it up to a 2.5, excels in computer-assisted drafting. The team members work well together, each contributing at his or her level and expertise.

John and the other students will remain in the Academy for five hours. Then they will usually go to lunch and two other classes in the regular high school—though some students get so wrapped up in their learning that they may eat lunch while working on their Academy projects. Their time in the Academy is divided between their computer workstation in the main computer lab and the science/technology education labs, which are the hubs for integrated learning. John is earning seven credits for the five hours per day that he spends in the Academy. His course work includes these subjects:

- Applied Math II
- Integrated Science III
- Applied Communications III
- Aerospace Technology I

- Drafting II
- Business Computer Applications I
- Diversified Cooperative Training.

Each student on John's team carries a slightly different course load. For example, Clarisa, who is more advanced in math, takes Algebra 2 Honors. She also chose to take Science Research, as a seventh credit, instead of Business.

Although teachers at CAAT do not teach entire courses on specific subjects, they do have subject-area specialties. Students meet with each of the subject-area facilitators at various intervals during their problem-solving projects. During those sessions, students receive instruction in the subject-area skills they will need to complete their projects. Hence, instruction focuses on fully understanding problems to be solved and on developing the skills and knowledge needed to solve those problems.

During a mathematics meeting called to review and clarify responsibilities for a new project, John joins students from other teams who are working on meeting standards for the same mathematics course as his, Applied Mathematics II. Although the members of John's team work together to solve the problem and meet the project criteria, each team member has a different responsibility (assigned according to course load), and each will be evaluated accordingly.

John quickly learned that all work in the Academy has to be completed—unlike in his other classes, where he could choose to not complete assignments and get a low grade. He also learned that even if he was not able to meet all of the criteria for which he was being evaluated on the first try, he would get as many opportunities as he needed to get it right, receive full credit, and achieve a grade of *A*.

The Academy evaluation system is based on mastery. Every student must meet a series of criteria that vary according to each student's individual education plan. Students meet their subject-area objectives in the process of completing their learning activities or projects. Students must achieve 100 percent mastery to receive a grade. A grade of "not yet" or "incomplete" is given to students whose work does not show mastery. Students then work at their own pace to complete the work. They are encouraged to strive for excellence. Once the work is complete and mastery has been achieved, the students receive an *A*. Students who do not demonstrate mastery by the end of a school year must repeat the course.

Toward the end of the five hours, John's team discusses the schedule for the next day. They assess their progress in completing the project and discuss what they need to do to stay on schedule. A debriefing by one of the facilitators marks the end of the Academy day. As the debriefing begins, John and the rest of the Academy students check off the day's completed objectives, which were established during the earlier briefing. John also transfers incomplete objectives to the next day's schedule and records any responsibilities he may have for that evening.

The Extended Classroom

In an effort to give students real-world learning experiences that go beyond the classroom, CAAT makes career shadowing, internships, and apprenticeship programs part of its curriculum. John and the other CAAT students will spend approximately 30 hours per school year at an aerospace worksite. There they are exposed to the day-to-day activities of an engineer, a technician, a mechanic, an inspector, a technical writer, an accountant, and so on. They not only become acquainted with the problems and challenges experienced by their mentors, they also get the opportunity to learn some of the skills intrinsic to those jobs. The students and their mentors focus on strengthening identified competencies and skills in the place where they can best apply them—the workplace.

The Results

CAAT has two independent evaluators that collect and analyze program data. NASA is both a CAAT business partner and one of its evaluators. It has studied the attendance rate, graduation rate, academic achievement, and students' involvement in community service, civic organizations, and schools clubs. The second CAAT evaluator is Manpower Demonstration Research Corporation (MDRC), an organization that conducts educational and social service evaluations and has made CAAT part of a national career academy study. MDRC has developed an evaluation model that tracks two cohorts of research and control groups for seven years and studies criteria such as attendance, academic achievement, graduation, postsecondary school enrollment, and employment.

The results from CAAT's first year indicate significant student improvement (10 percent or more) in the following areas: attendance, academic achievement, math ASVAB (Armed Services Voca-

tional Aptitude Battery) scores, and graduation statistics (100 percent of CAAT's seniors graduated on time).* The average GPA of both incoming CAAT students and students in Cocoa High School was 2.2 in the first year. Besides the overall results of year one, there were some dramatic individual student success stories. Qualitative results indicated that 48 percent of the students enjoyed school more in the Academy, 69 percent planned to enroll again, and 98 percent did enroll again.

• • •

We set out to make the objectives of our school-to-work transition program congruent with students' needs: to prepare students for the workplace and for postsecondary education. In planning the program, we looked at many models of education, including "technology education," which is described in the next chapter.

*Based on data collected by NASA during the first year.

2

BEGINNING WITH TECHNOLOGY EDUCATION

As our young people enter the 21st century, more jobs will require workers to not just be familiar with technology, but to adapt to frequent changes in technology. Inescapably, we are speeding toward a future where the need for information will keep us dependent on technological mastery in order to survive. David Thornburg (1994, p. 20) has said that we have gone past even the Information Age, that we are in fact in the Communication Age, and that new "technologies will merge and become transportable, empowering students to take more proactive roles in the acquisition of knowledge." Therefore, when the learning community at Cocoa High School began to discuss how to build relevancy into a high school curriculum, we looked at our definition of technology and the role of technology education.

What Is Technology?

The word "technology" evokes a myriad of meanings, images, and emotions: computers, printers, fax machines; fear, frustration, determination, elation; a bright future, a dismal layoff. It is linked historically to the 20th century and futuristically to the 21st.

Over a century ago, Ralph Waldo Emerson had this to say about the technology of the day in his essay "Self Reliance":

> The civilized man has built a coach, but has lost the use of his feet. He is supported on crutches, but lacks so much support of muscle. . . . His notebooks impair his memory; his libraries overload his wit; the insurance office increases the number of accidents; and it may be a question whether machinery does not encumber. . . .

The idea that we are perhaps handicapped by technology is still held by some today.

At CAAT, we choose to think of technology as the application of knowledge, creativity, and resources to solve problems and extend human potential. This definition takes into account that there is a human need for change and that the harvest of technological change is more technology. That is to say, the continuing quest to make things better always results in more technology.

Whatever the definition, few people would disagree that the only thing constant about technology is change. Although technological change is not unique to our times, the rate of change over the past century has resulted in an ever larger group of people who are technologically illiterate. If the people of the world were divided into two groups according to their technological literacy, the first group would contain the creators and users of technology. These people are comfortable using technology; moreover, they are adept at inventing technology—using the technological *process*. The other group would be composed of individuals who are dependent on the first group. While they want the advantages of new technology, they are intimidated by the requirement for reeducation. Their want is not as great as their need to avoid failure and frustration. Education must keep pace with technological change or the gap between the two groups of people will broaden and become increasingly more difficult to bridge.

What Is Technology Education?

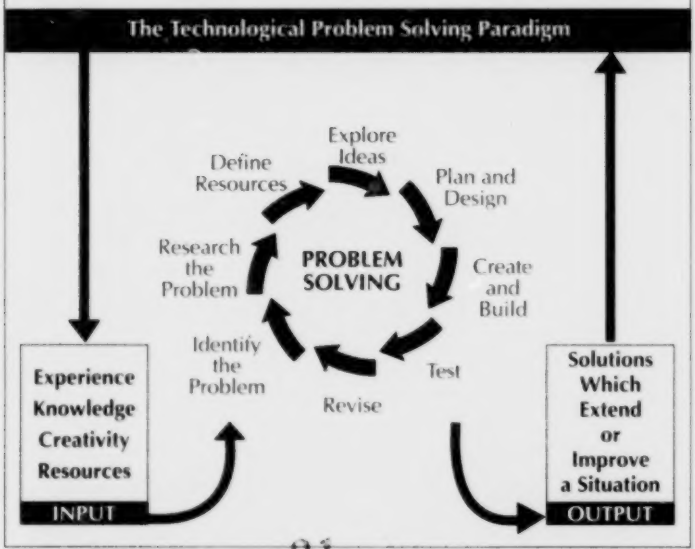
In the mid-1980s, industrial arts programs in schools across the United States (including Cocoa High) responded to the changing needs of industry by developing into what is now called technology education. The transformation was not unexpected, since vocational programs have historically had to modify their course offerings to meet the needs of the systems they serve. This evolution brought with it curriculum changes that responded directly to the requirements of industry. In other words, technology education developed out of the need to prepare students for the technological demands of our society.

The International Technology Education Association has defined technology education as the application of knowledge, creativity, and resources to solve problems and extend human potential. Technology education offers students hands-on experiences with existing technologies as well as opportunities to invent new technologies. Students gain experience with the technological tools they will be expected to use when they graduate, and they are immersed in a technological learning-to-learn paradigm: the technological problem-solving process.

The Technological Problem-Solving Process

The technological problem-solving process requires participants to think critically, creatively, and resourcefully while employing basic academic, technical, and social skills. Their objective is to come up with a solution or improve a particular situation. The framework below shows the basic elements of the problem-solving process, and Figure 2.1 shows a graphic image of the relationship among the elements of this process.

Figure 2.1
A Framework for Problem Solving



1. *Input.* What the student brings to the problem-solving process:
   - Experience
   - Knowledge
   - Creativity
   - Resources

2. *Process.* The steps the student follows in the problem-solving process:
   - Identifies/recognizes the problem
   - Researches/analyzes the problem
   - Defines available resources and design criteria parameters
   - Explores ideas
   - Plans/designs
   - Creates/builds
   - Tests
   - Revises

3. *Output.* The solutions the student discovered to extend or improve a situation.

Cocoa Academy's model for seamlessly integrating academic and vocational curricula grew out of these basic principles of technology education and the technological problem-solving process.

Technology Learning Activities (TLAs)

At the Academy, *technology learning activities* (TLAs) are an important part of the curriculum. TLAs are hands-on, problem-solving activities designed by technology educators to conform to the problem-solving framework described above. They offer students opportunities to use technological tools as well as technological methods. A single TLA requires students to apply knowledge learned across several disciplines, to think critically, solve problems, research, analyze information, make difficult choices, plan strategies, manipulate materials, work cooperatively with peers, and evaluate outcomes. The interdisciplinary nature of the TLA helps students discover the links between various subject areas. TLAs teach students the skills necessary to function in an increasingly technological society. Figure 2.2 shows a TLA written for a computer integrated manufacturing (CIMS) course.

Figure 2.2
Technology Learning Activity
"Creative Designs"

Situation
The XYZ Company is promoting innovative products at their International Convention. You and your creative team members have decided to participate in this event. There are unlimited possibilities for products which you may explore to win international publicity.

Solution
Research, brainstorm, design, and build a product that has a practical use.

Design Brief

Other Criteria
Team must document brainstorming process.

a. Individuals must come up with at least 3 practical ideas and sketches.
b. Team must decide on one product with sketches included from individual selections.

2. Working drawings must be completed on CADD.
3. Complete a materials list that includes rough and finished materials.
4. Present a step-by-step plan of procedure which includes all processes and machines used.
5. Each team's contest entry must be mailed out by _____ (to be determined by teacher).
6. Contest entry must be received, critiqued, and built.

Resources

Time:	30 hours
Energy:	Human, electrical, pneumatic, hydraulic, mechanical
People:	Team members
Knowledge:	Media Center, facilitator, textbooks, team members, members of the community, owners manuals.
Materials:	Paper, pen/pencil, facilitator-approved materials
Capital:	None
Tools/machines:	Computer, CD-ROM, equipment available in tech lab.

We saw the potential for technology learning activities (or a variation of them) to provide what we had identified as key elements of our integrated curriculum:

- Learning-to-learn situations
- Vehicles for integrating vocational/technical and core academic concepts
- Simulations for "workplace know-how" or what "work requires of school" (U.S. Department of Labor 1991)
- Opportunities for creative thinking and problem solving

Change Begets Change

The Cocoa Academy began with a vision to integrate all of the core academic areas with specific vocational/technical courses. As we developed our program, we realized that technology education and the technological problem-solving process in particular were essential components of curriculum integration. We also realized that in order to achieve the level of integration we envisioned—seamless integration—we would have to change schooling as we knew it.

3

MOVING TOWARD VIRTUAL LEARNING

Trying to integrate academic and vocational education by changing only the curricula is like trying to bake a layer cake in a cupcake pan. No matter what the ingredients, the result is still separate cupcakes, not a complete cake. If we wanted the boundaries between subject areas to be as transparent as possible, we would have to change other aspects of our program, such as the facility, the scheduling, the delivery of instruction, and the methods for evaluating and grading. Only by removing the limitations of the traditional high school would we have any chance of realizing our vision of seamless integration.

As we broke through some of the boundaries imposed by the traditional high school system, a new system began to emerge, one that provided a way to achieve curriculum integration. We called this system Virtual Learning, as it was a system of learning that takes place neither in the "real world" nor in the artificial environment of the classroom. It was, in fact, a kind of corporate simulator: a Virtual Learning place. As we continued to develop it, Virtual Learning took on 10 distinguishing features:

1. Facilitators and students teach each other how to learn
2. The curriculum blends a spectrum of disciplines to satisfy measurable desired learning objectives.
3. There are no single-discipline teachers.
4. Students learn in teams, practicing cooperative learning skills.

5. Facilitators teach in teams.

6. The curriculum contains problem-solving activities that require more than one answer.

7. All problem-solving activities must have real-word relevancy.

8. Everyone practices continuous quality improvement.

9. Learning takes place in an environment that mimics the real world.

10. Authentic assessment is used to test all measurable desired learning objectives.

1. Facilitators and students teach each other how to learn.

Paulo Freire (1970, p. 66) says that learning takes place when "the teacher is no longer merely the-one-who-teaches, but one who is himself taught in dialogue with the students, who in turn while being taught also teach." In the Virtual Learning environment there are no students-of-the-teachers or teachers-of-the-students; there are only, as Freire describes, "student-teachers" and "teacher-students." In other words, all participants in the Virtual Learning environment are learners.

What Freire (1970, p. 66) describes as "problem-posing" education is essential to this new relationship between teacher and student. He contrasts problem-posing education to what he calls "banking education," in which the teacher "deposits" information into the minds of the students, and "the students patiently receive, memorize and repeat" (p. 58) the information back to the teacher. As Freire emphasizes, there is no communication or dialogue in this instructional technique. Teachers and students must develop a trusting relationship, so they will enjoy greater opportunities for learning from one another. Only so long as teachers and students continue to learn from one another will a productive learning environment exist.

2. The curriculum blends a spectrum of disciplines to satisfy measurable desired learning objectives.

To say that Virtual Learning integrates academic and vocational curricula does not tell the entire story. A better explanation is that Virtual Learning uses the basic skills associated with academic education to teach vocational/technical skills; at the same time, it uses vocational/technical fields to teach academics. Rather than using existing or prepackaged curricula (academic or voca-

tional) that may or may not meet student learning needs, Virtual Learning builds a strong, integrated curriculum framework based on performance outcomes that specify what students will need to know and be able to do if they are to thrive in the 21st century. Discrete curriculum areas do not exist; the total academic/technical program is seamless.

3. There are no single-discipline teachers.

Just as there are no discrete curriculum areas, there are no single-discipline teachers. Although instructors in a Virtual Learning setting have particular subject-area expertise, they are also generally familiar with all aspects of the curriculum and can coach students. When necessary, a teacher may call for assistance from another teacher who is especially skilled in a particular subject.

4. Students learn in teams, practicing cooperative learning skills.

In the cornerstone work on cooperative learning, *Cooperation in the Classroom*, Johnson, Johnson, and Holubec (1988) propose that cooperative learning is not a new idea; it is as old as humankind. They suggest that the Talmud makes reference to the need for learning partnerships and cite noted figures in history—such as Joseph Lancaster, Andrew Bell, Colonel Francis Parker, and John Dewey—as proponents of cooperative learning strategies.

As defined by Johnson, Johnson and Holubec (1988), cooperative learning includes these basic elements:

- *Positive Interdependence.* Students should have mutual objectives that require them to depend on one another for success.
- *Face-to-face Interaction.* Positive interdependence is most likely when students are able to interact with one another face-to-face, in conversation.
- *Individual Accountability.* Although learning takes place cooperatively among team members, each student is assessed individually at the conclusion of an activity.
- *Interpersonal and Small-Group Skills.* Students must learn the social skills required to successfully interact in small groups.
- *Processing.* The cooperative group's assessment of their own strengths and weaknesses, successes and failures, is an important part of cooperative learning.

"An essential instructional skill that all teachers need is knowing how to structure students' learning goals cooperatively, com-

petitively and individualistically" (Johnson, Johnson and Holubec 1988, p. 1:4). The implication is that all three of these "goal structures" have equal worth in the classroom.

CAAT's Virtual Learning environment closely follows the above model of cooperative learning:

- Students must work together to solve problems, and the steps of the problem-solving process include the ingredients of group processing—specifically, brain-storming, negotiating, leadership, communication, reaching consensus, and conflict resolution.
- Teams are heterogenous.
- Although students must work together to solve a particular problem, they must work independently to fulfill their separate course requirements. In this way, positive interdependence is created. The students each have a job they must complete in order to solve the problem and complete the activity. Assessment is done individually, so that the student's contributions to solving the problem as a team member are evaluated, as is individual coursework.

Cooperative learning is closely aligned to one of the skills industry values most, teamwork. The SCANS report (U.S. Department of Labor 1991) emphasizes the importance of interpersonal competency, or working with others. It says that the application of interpersonal skills includes: participating as a team, teaching others new skills, exercising leadership, negotiating to reach an agreement, and working well with men and women from diverse backgrounds. Cooperative learning helps all students develop these skills, regardless of career direction. "None of us is as smart as all of us" is a credo of Virtual Learning.

5. Facilitators teach in teams.

Just as cooperative learning is not a new idea, neither is team teaching. In the 1960s and '70s, the concept of pod teaching or open classrooms was popular. The open classroom was meant to give teachers the flexibility of working cooperatively with one another. Proponents of this strategy believed it would eliminate the confinement and isolation felt by the many teachers who spend their entire day in the same room with one group of children. They also suggested that the benefits of teacher collaboration would have a positive effect on instruction and that the

open classroom would offer the efficiency of shared facilities. As with many well-intentioned ideas, however, the open classroom/team-teaching strategy was short-lived, primarily because teachers were unprepared for the demands of their new situation.

When teachers have been properly trained and prepared, team teaching can benefit any school program. In a seamlessly integrated curriculum, team teaching is essential. Even at the lowest levels of integration, teacher collaboration is necessary. Team teaching and teacher collaboration are distinguished here by the level at which teachers work together. Grubb (1991), Blank and Scaglione (1992), Fogarty (1991) and Jacobs (1989) assert that all levels of integration, including the lowest level, must start with teacher collaboration. Most researchers agree that the need for teacher collaboration increases when discrete disciplines become less defined. In a seamlessly integrated curriculum, the level of teacher collaboration requires a commitment to team teaching.

Teachers at CAAT, representing expertise in each of the core academic areas and in specialized vocational/technical areas, work together to develop policies and procedures, write curriculum, implement the curriculum, facilitate instruction, plan and schedule activities, discipline students, and assess student progress. Their individual contributions to the overall instructional process of Virtual Learning are much like those of musicians in an orchestra. Each has his or her specific instrument to play, but only with the other musicians can they perform a symphony.

Perhaps one of the strongest arguments for team teaching is that it encourages us to "walk our talk"—that is, it allows us to model many of the skills we are trying to teach and that industry tells us are essential to "workplace know-how." For example, teachers have become strong models for teaming skills, leadership skills, and skills for teaching and working with people of diverse backgrounds.

6. The curriculum contains problem-solving activities that require more than one answer.

The problem situations around which the curriculum is developed will never have only one correct answer. Rather, students will find multiple solutions to any given problem situation. Therefore, it is the problem-solving *process* that becomes equally, if not more, important to learning than actually creating the product or finding the solution.

If students are to truly learn from problem-solving activities, teachers must learn how and when to say "I don't know." They must be willing to allow students to learn by discovery. Whether or not the teacher knows a correct answer, "I don't know" must imply to the student that "I believe you can find a solution to the problem with the resources I have provided." Of course, they must also know when to discuss processes with students and offer advice so that students don't feel abandoned. "Knowledge emerges only through invention and re-invention, through the restless, impatient, continuing hopeful inquiry men pursue in the world, with the world, and with each other" (Freire 1970, p. 58).

7. All problem-solving activities must have real-world relevancy.

Cognitive research has shown that when we are engaged emotionally as well as intellectually, we learn better (Flowers 1988). It has further shown that we are most successful when learning about things that deal with situations, problems, and experiences that are meaningful to us and have some bearing on our lives. The Virtual Learning environment requires that all learning activities have real-world relevancy in order to encourage perseverance and facilitate learning.

Hands-on applied learning is one of our strategies for achieving real-world relevancy. We define it as a learning experience that involves all modalities (e.g., visual, auditory, kinesthetic, tactual), requires students to demonstrate real-world social skills as they learn (i.e, the cooperative learning model described earlier in this chapter), and incorporates activities that are relevant to students' lives.

Generally speaking, applied learning often refers to low-level integration strategies—that is, on Norton Grubb's (1995, p. 67) integration continuum, "making academic courses more applied or vocationally relevant" falls on only the third rung of an eight-rung ladder. When considering applied learning as one of the several alternative teaching strategies in a seamlessly integrated curriculum, however, it is truly "one of the most powerful strategies involved in integration" (Blank and Scaglione, 1992, p. 27).

CAAT incorporates applied learning by making sure that:

- Activities have relevance to students' lives.
- Activities require students to solve problems by using all learning modalities: visual, auditory, kinesthetic, and tactual.
- Activities have hands-on, design, build, and test components.

• Students practice real-world social skills by cooperating and collaborating in teams to solve problems and complete activities (cooperative learning).
• Activities require that students "do" in order to learn.

Over the last ten years, in support of the movement to integrate academic and vocational secondary education, the Center for Occupational Research and Development and the Agency for Instructional Television have developed prepared "applied" materials for instruction in mathematics, science, and language arts. These materials supplement the activities developed at CAAT; they also can be used as a starting point for integration.

8. Everyone practices continuous quality improvement.

W. Edwards Deming (1986) defined continuous improvement as (1) clarifying the aim of the system; (2) assessing the needs of the client in relation to the aim; (3) determining the best instructional strategies to meet the needs of the individual; and (4) all parties working to improve the process of teaching and learning. Therefore, the Virtual Learning environment requires the collective cooperation of all participants to reduce the variations within the system and to increase the expectations of the individual.

9. Learning takes place in an environment that mimics the real world.

While the institutionalization of education has distanced it from learning in situ, the Virtual Learning environment simulates the "real world" of its participants. If the aim of a learning system is to prepare students to enter a high-tech workplace and to continue their education, the expectations and resources of that system must closely resemble these aims.

10. Authentic assessment is used to test all measurable, desired learning objectives.

The term "authentic assessment" has come to mean many things to many people. In its simplest definition, authentic assessment is evaluating a skill or knowledge in a way that is connected and relevant to the application of that skill or knowledge. For example, to authentically assess the ability of a student pilot to land an airplane, the flight instructor would require the student to fly an airplane solo. From a vantage point on the ground, the

instructor would judge the success of the landing. Here are some other tasks the instructor might require the student to perform:

- Write a list of procedures for landing an airplane.
- Give a speech on how to land an airplane.
- Successfully land a Flight Simulator.
- Present a logbook containing a written record of hours flown.
- Use a model airplane to demonstrate a safe landing.
- While on the ground, sit in the cockpit and go through the landing checklist.
- Land an airplane with the flight instructor on board.

Although these evaluations do not tell us whether a pilot can actually land a plane, they could be used to authentically assess other skills, such as the pilot's ability to recall a series of procedures or give a speech. It is important to understand that it is not simply the method of assessment that determines its authenticity; it is how the method applies to what is being assessed. Authentic assessment cannot take place without a clear understanding of what is being assessed and how what is being assessed is relevant to the real world.

Wiggins (1991) suggests that "authenticity in assessment ensures that students are learning new information and skills within a context that is as close to a real life setting or position as the situation would allow." In fact, real authenticity requires that instructional and assessment methods reflect the realities of the world outside of school. In addition, authentic assessment requires that the student "take an active part in any learning event." Wiggins advocates student choices in time management, materials, and the criteria for assessment.

Authenticity refers not only to the method by which students will be assessed, it also includes the grade or indicator of success that will be attached to a student's performance. In authentic assessment, letter grades have nothing to do with the real world. If we revisit the example of the airplane pilot, the need for authenticity becomes clearer. From the flight instructor's perspective there is only one passing grade or indicator of success: the solo student lands, taxis to the tie-down area, and exits from an undamaged aircraft. Anything less than that is unacceptable. What other choice is there? If the aircraft was only slightly damaged what grade should the student pilot receive? Would a small crash rate a *D* or perhaps a *C* because, even though the student crashed,

he attended all of the ground school classes and was polite to the instructor? This example of inauthentic grading is, thankfully, prohibited by Federal Law.

The flight instructor also has an ethical obligation to his student and, in a much larger sense, to the general public. Suppose that a student has made dozens of successful landings without any help from the flight instructor. However, in this situation the instructor has always been in the airplane. The instructor believes the student has the ability to land a plane solo, but the student has never been allowed to do so. Without an authentic assessment, would you allow a loved one to be the first to fly with this student without an instructor on board?

At CAAT, learning goals are specified as performance outcomes. Methods of assessing whether students have achieved the performance outcomes include facilitator observation, peer evaluation, self-evaluation, and portfolios. In a Virtual Learning environment, 99.9 percent is not good enough. Students are expected to achieve 100 percent of every performance outcome that they and their facilitators have agreed to in their educational plans. Students receive continuous feedback, working and reworking assignments at their own pace until they have achieved the excellence expected of them.

CAAT's assessment and grading system is in harmony with school-to-work transition goals in the following ways:

- It supports Deming's Continuous Quality Improvement philosophy, specifically point #3: "Cease dependence on inspection to achieve quality" (Warwick 1992). From an educational point of view this means using criterion-referenced, authentic assessment and eliminating rating and ranking of students.
- It requires that students master 100 percent of the performance outcomes.
- It supports the research showing that grades inhibit students' intrinsic motivation to learn (Kohn 1993, pp. 202–203).
- It supports the recommendations in the SCANS report, "What Work Requires of Schools" (U.S. Department of Labor 1991).
- It provides continuous feedback to students that is neither punishing nor rewarding. Students are thus empowered to improve the quality of their work.
- It creates a caring learning community—free from competition and dependent on collaboration.

Some people believe that 100 percent mastery is an unrealistic expectation. In the real world, however, 99.9 percent accuracy is intolerable in many areas. For example, if doctors who deliver babies dropped them 0.1 percent of the time, 50 newborn babies in the United States would be dropped at birth each day. Furthermore, being right only 99.9 percent of the time there would be in the United States:

- One hour of unsafe drinking water a month
- Two unsafe landings at O'Hare airport each day
- Sixteen thousand pieces of lost mail per hour
- Twenty thousand incorrect drug prescriptions per year
- Five hundred incorrect surgical operations every week

Eliminating grades and replacing them with "informational feedback" is an approach recommended by Alfie Kohn (1993, p. 202). When educators are required to use a grading system, Kohn suggests they reduce the number of grades given to include fewer ranks. For example, students may receive a grade of *A* or "passing" when they have achieved 100 percent mastery and a grade of "not yet" when mastery has not been achieved. CAAT's approach is in line with these recommendations.

Important Questions

For a learning environment to be considered one of Virtual Learning, the learner must be able to answer yes to each of the following questions:

- Are you both a student and a teacher?
- Is it necessary to use knowledge from more than one subject area in order to complete the problem-solving activities?
- Do all facilitators help with more than one subject?
- Do you cooperate with others in order to learn?
- Do the facilitators cooperate in order to teach?
- Are there multiple solutions to all problems?
- Can you apply what you learned in the problem-solving activities to the real world?
- Are you always expected to complete 100 percent of the activity to the best of your ability?
- Do the expectations and resources of your learning environment simulate the real world?
- Are you evaluated in a way that tests your achievement of stated learning objectives by way of performance outcomes?

* * *

As you can see, Virtual Learning incorporates many theories about teaching and learning that research has shown to be effective. It is the way in which these sound principles have been put to work, however, that makes Virtual Learning unique.

4

VIRTUAL LEARNING ACTIVITIES

Having identified technology education and the problem-solving process as a strong foundation for curriculum relevancy and having recognized the technology learning activity as a valuable agent for curriculum integration, the next step for the CAAT team was to apply these principles to creating a comprehensive curriculum that would include all the core academic areas and specific vocational/technical disciplines. The result was a project-based curriculum that used a version of the technology learning activity as the primary vehicle for the integration of vocational and academic education at the Cocoa Academy. We called this activity a Virtual Learning Activity.

Evolution and Design

Virtual Learning Activities (VLAs) are modeled after technology learning activities (TLAs, described in Chapter 2). The principle difference between them is their scope. In a traditional high school, TLAs are used by the technology education teacher to reinforce basic academic skills while teaching technology education objectives; at CAAT, VLAs are used to teach all the core academic objectives as well as specific vocational/technical ones.

A Virtual Learning Activity includes three elements: the Student Page, the Content Connections Page, and the Teacher Pages. The first two elements closely model the structure of the TLAs

described in Chapter 2, while the third, the Teacher Pages, marks the major difference between TLAs and VLAs.

The Student Page

Figure 4.1 on page 30 shows an example of a Student Page developed by CAAT staff members. As you can see, it has three parts: the situation statement, the solution statement, and the design brief. The situation statement sets the stage for students by posing a real-world problem for students to solve (step 1 of the problem-solving process discussed in Chapter 2). The solution statement delineates the problem presented in the situation statement and directs students to "do" something in order to solve the problem (step 2 of the problem-solving process). The design brief lists the constraints within which students must work, the criteria they must meet (step 3 of the problem-solving process) and the "real-world" resources that the students have at their disposal: time, energy, people, knowledge, materials, capital, tools, and equipment (step 3 in the problem-solving process). Students are limited to the resources listed in the design brief.

The Content Connections Page

The Content Connections Page simply points out the various links between subject areas that can be addressed and reinforced in the learning activity. By identifying these connections, teachers can assist students in making the links between subject areas. Figure 4.2 on page 31 shows an example of the Content Connections Page for the safe waters activity.

Teacher Pages

Teacher Pages are an important part of each integrated learning activity. It is these pages that mark the difference between the limited objectives of the TLA and the broader scope of the VLA. The Teacher Pages contain four sections:

- Measurable desirable Learning Objectives
- Teacher Methodology and Activities
- References and Resources
- Performance Outcome

The Teacher Pages identify for the facilitator the measurable desired learning objectives that students must achieve and the evaluation criteria that may be used to assess or measure the

Figure 4.1
Student Page for Safe Waters VLA

Situation Statement
You and your team members are on an expedition in Antarctica. Your journey has been thwarted by a large, water-filled crevice in the ice. In order to complete your expedition you must find a way to cross the fissure.

Solution Statement
Design and build a model of a device that will carry as many people and supplies as possible across the icy water. Use the least amount of materials possible.

Design Brief

Criteria
- Brainstorm with team members.
- Device must be safe.
- Device must hold as many people and supplies as possible (one marble equals one person and her supplies).
- Design device using Computer Aided Design and Drafting software
- Construct device using high quality craftsmanship.
- Test device in area provided.
- Modify as needed to improve performance.
- Each team member must write a memo to the home office reporting on the successes and shortcomings of the mission. The memo must include the total cost of the final device, the number of people, the weather conditions and details of the mission.

Resources

Time:	3 days
Energy:	Human
People:	Team members
Knowledge:	Textbooks, handouts, facilitators, team members
Materials:	4" x 4" aluminum foil, marbles, 6" masking tape
Equipment:	Scissors; rulers
Capital:	Each square inch of aluminum foil costs $1.25 Each inch of masking tape costs 10 cents

Figure 4.2
Content Connections Page for Safe Waters VLA

Business Computer Applications
Prepare a memorandum
Use word-processing

Language Arts
Use correct English to write a memorandum
Work in teams (small group discussion)

Mathematics
Demonstrate problem-solving skills
Manipulate two and three-dimensional objects
Work with vectors
Use formulas to solve a problem
Perform basic calculations

Science
Calculate area and volume
Apply knowledge of displacement and buoyancy
Use scientific method to solve problems

Technology Education
Apply design and problem-solving processes
Use problem-solving and critical-thinking skills
Use Computer Assisted Design and Drafting software to draw vehicle

Figure 4.3
Language Arts Teacher Page for Safe Waters VLA

Course: Writing II
Date:
Title: Safe Waters

Measurable Desired Learning Objectives
To write sentences and paragraphs, using all stages of the writing process
To use standard written English
To peer edit
To develop vocabulary

Teacher Methodology and Activities
Review criteria for memo writing and peer editing
Conduct small-group discussion
Begin VLA
Conduct competition for safest, most efficient device

References and Resources
Facilitators
Computers, software, CDS
"Archimedes, A Gold Thief, and Buoyancy" (*Sources*, July/August 1993)

Performance Outcome
Students may receive full credit for this activity by reporting the results of the VLA in a memo that uses standard written English and all stages of the writing process.

performance outcomes. Helpful hints about methodology and suggested references are also available on the Teacher Pages. A VLA will have a Teacher Page for each core academic subject as well as specific vocational/technical courses. Figure 4.3, on the opposite page, shows an example of a Teacher Page for language arts that is part of the safe waters VLA.

A Driving Force for Systemic Change

In attempting to integrate academic and vocational education, we knew that we would have to set aside traditional ideas about teaching and learning and embrace a new paradigm. Technological learning activities helped us take our first tentative steps out of the traditional classroom. With the development of Virtual Learning Activities, we were off and running, ready to reshape teaching and learning for the next century.

5

PUTTING THEORY INTO PRACTICE

The distinguishing feature of the Cocoa Academy is that the VLA and the Virtual Learning environment replace the traditional separation of vocational and academic education. Virtual Learning Activities were created to provide students with hands-on problem-solving activities that would enable them to achieve performance outcomes in both the core academic areas and the vocational/technical areas. In other words, by applying both academic and vocational knowledge to the creative process of "doing," students can achieve new levels of proficiency.

Identifying Learning Objectives and Developing a Curriculum Framework

"The starting point for any school or education system must really be a definition of what high school graduates must know and be able to do to be successful in adult life" (Dagget 1995, p. 51). "Unfortunately," says William Spady (1995, p. 82) "the majority of national, state, and local standards being proposed today are overwhelmingly educentric"—that is, they are standards that serve the existing educational system, not the student and definitely not school reform. Like Dagget, Spady believes "content standards that define what it means to be a good student within the traditional system do not prepare students for the rapidly changing future they face."

At the Cocoa Academy we realized that it was essential to begin with measurable learning objectives that defined what students would need to know and be able to do in their adult lives. It was also essential to have a strong curriculum framework to organize those goals. The process of developing a curriculum framework and learning objectives—and getting an entire learning community to agree on them—is an enormously complex task. We began by forming a curriculum subcommittee composed of key stakeholders, including teachers, administrators, students, parents, representatives from business and industry, and district personnel.

1. *Examine Existing Frameworks.* The committee began by examining the existing curriculum frameworks for each subject area that had been established by the state and our school district and then posing the following questions:

- Are the existing frameworks mandated?
- If existing frameworks are mandated, can a waiver be obtained to alter or enhance them?

As long as the frameworks can be altered, it's possible to proceed with this process.

2. *Determine whether the learning objectives in the curriculum frameworks balance the acquisition and application of knowledge.* We found that many of the learning objectives in the existing frameworks required students to acquire knowledge; few learning objectives required them to apply that knowledge. Therefore, we enhanced the existing frameworks with more applied objectives, particularly in the academic areas. When possible, we borrowed from applied academic curricula objectives that had been adopted by the state. For example, we enhanced the existing physics frameworks by including objectives from a state-adopted applied physics course called Principles of Technology.

3. *Evaluate the frameworks' relevancy to what students need to know and be able to do in the 21st century.* The diverse composition of the curriculum subcommittee was particularly valuable in this effort to identify the variety of skills needed to thrive in the 21st century.

4. *Identify the discrepancies between the existing curriculum frameworks and the skills and knowledge identified by the curriculum subcommittee as essential for its graduates.* Identifying the gaps in the current frameworks can be an important step in gaining support from those who may be skeptical of these change efforts.

5. *Compare the existing curriculum frameworks to the competencies and foundations identified in the SCANS report.* We developed a matrix that compared the competencies and foundations identified in the SCANS report with each of our academic and vocational course frameworks (see Figure 5.1 for excerpts from the SCANS report). The matrix enabled us to identify whether or not our frameworks addressed all of the SCANS competencies and foundations.

Integrating and Articulating Measurable Desired Learning Objectives

Once we had identified what we thought were meaningful and measurable learning objectives in each of the academic and vocational subject areas, we began to look for connections among the different subjects. Duplicate learning objectives were the obvious starting point, but we also looked for learning objectives that were compatible or positively interdependent with each other. For example, we found two positively interdependent learning objectives in language arts and in business computer applications:

- To use standard English to compose a business letter. (language arts)
- To use word processing to create a business letter. (business)

Although the two learning objectives were similar, the criteria for measuring each were different; presenting the goals in tandem, as integrated learning objectives, would have obvious advantages.

We completed this step of the process by comparing the integrated learning objectives with the SCANS competencies and foundations to ensure that they, too, would be met.

Establishing Scope and Sequence and Identifying Unit Themes

We began this step by examining the existing scope and sequence for each of the academic and vocational courses in light of the newly developed cross-disciplinary links that had been made. In other words, we coordinated the introduction of learning objectives across subject areas, making sure that we could actually accommodate the integrated learning objectives.

Then we focused on identifying unit themes. We developed unit themes around "big ideas" or concepts that reflected the new integrated course frameworks. For example, "energy" is an excellent unit theme because it crosses many disciplines. A lesson on

Figure 5.1
Key Elements of the SCANS Report

FIVE COMPETENCIES

Resources: Identifies, organizes, plans, and allocates resources
A. *Time*—Selects goal-relevant activities, ranks them, allocates time, and prepares and follows schedules.
B. *Money*—Uses or prepares budgets, makes forecasts, keeps records, and makes adjustments to meet objectives
C. *Material and Facilities*—Acquires, stores, allocates, and uses materials or space efficiently
D. *Human Resources*—Assesses skills and distributes work accordingly, evaluates performance and provides feedback

Interpersonal: Works with others
A. *Participates as Member of a Team*—contributes to group effort
B. *Teaches Others New Skills*
C. *Serves Clients/Customers*—works to satisfy customers' expectations
D. *Exercises Leadership*—communicates ideas to justify position, persuades and convinces others, responsibly challenges existing procedures and policies
E. *Negotiates*—works toward agreements involving exchange of resources, resolves divergent interests
F. *Works with Diversity*—works well with men and women from diverse backgrounds

Information: Acquires and uses information
A. *Acquires and Evaluates Information*
B. *Organizes and Maintains Information*
C. *Interprets and Communicates Information*
D. *Uses Computers to Process Information*

Systems: Understands complex inter-relationships
A. *Understands Systems*—knows how social, organizational, and technological systems work and operates effectively with them
B. *Monitors and Corrects Performance*—distinguishes trends, predicts impacts on system operations, diagnoses systems' performance and corrects malfunctions
C. *Improves or Designs Systems*—suggests modifications to existing systems and develops new or alternative systems to improve performance

Technology: Works with a variety of technologies
A. *Selects Technology*—chooses procedures or equipment including computers and related technologies
B. *Applies Technology to Task*—Understands overall intent and proper procedures for setup and operation of equipment
C. *Maintains and Troubleshoots Equipment*—Prevents, identifies, or solves problems with equipment, including computers and other technologies

(continued)

Figure 5.1—*continued*
Key Elements of the SCANS Report

A THREE-PART FOUNDATION

Basic Skills: Reads, writes, performs arithmetic and mathematical operations, listens and speaks

A. *Reading*—locates, understands, and interprets written information in prose and in documents such as manuals, graphs, and schedules
B. *Writing*—communicates thoughts, ideas, information, and messages in writing; and creates documents such as letters, directions, manuals, reports, graphs, and flow charts
C. *Arithmetic/Mathematics*—performs basic computations and approaches practical problems by choosing appropriately from a variety of mathematical techniques
D. *Listening*—receives, attends to, interprets, and responds to verbal messages and other cues
E. *Speaking*—organizes ideas and communicates orally

Thinking Skills: Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn, and reasons

A. *Creative Thinking*—generates new ideas
B. *Decision Making*—specifies goals and constraints, generates alternatives, considers risks, and evaluates and chooses best alternative
C. *Problem Solving*—recognizes problems and devises and implements plan of action
D. *Seeing Things in the Mind's Eye*—organizes, and processes symbols, pictures, graphs, objects, and other information
E. *Knowing How to Learn*—uses efficient learning techniques to acquire and apply new knowledge and skills
F. *Reasoning*—discovers a rule or principle underlying the relationship between two or more objects and applies it when solving a problem

Personal Qualities: Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty

A. *Responsibility*—exerts a high level of effort and perseveres towards goal attainment
B. *Self-Esteem*—believes in own self-worth and maintains a positive view of self
C. *Sociability*—demonstrates understanding, friendliness, adaptability, empathy, and politeness in group settings
D. *Self-Management*—assesses self accurately, sets personal goals, monitors progress, and exhibits self-control
E. *Integrity/Honesty*—chooses ethical courses of action

Source: U.S. Department of Labor, Secretary's Commission on Achieving Necessary Skills (SCANS) 1991.

energy may involve a problem-solving activity in which students are part of a futuristic intergalactic mining firm that has just landed on a new planet rich in mineral resources. The students must come up with a plan to mine the planet, periodically recharge their life support systems, graph all results, complete several economic reports, and maintain a process analysis report. The opportunities for integrating vocational and academic learning in such an activity are far-reaching.

Another example of an energy-related activity is one in which the students are asked to develop a product using recyclable materials. Students are required to design the product using computer-aided design software, to provide a written rationale for its environmental benefits, and to develop a marketing plan. Once again, this problem-solving activity provides students with opportunities to meet a wide range of integrated learning objectives.

Figure 5.2
Thematic Units for First Year of CAAT

Unit I. Exploration (1st quarter)
A. Of the Academy resources, philosophy, and technology
B. Of aerospace and high tech careers
C. Of energy sources
D. Of space (planetary)
E. Of self

Unit II. Communication (2nd quarter)
A. In small groups
B. Interpersonal and intrapersonal
C. Audio
D. Visual
E. Audio-visual

Unit III. Transportation (3rd quarter)
A. Land
B. Water
C. Air
D. Space (rocketry)

Unit IV. Connections (4th quarter)
A. Systems
B. Integrated project connecting themes I, II, and III

Unit themes helped us to organize integrated learning objectives as well as to provide even more opportunities for making connections between subject areas. When choosing themes, we considered a number of issues:

- The themes should connect strongly to the measurable learning objectives.
- The themes should be broad enough to encompass all the integrated learning objectives that students are expected to meet for a particular unit.
- The themes should be relevant and interesting to the entire learning community.

Figure 5.2 shows an example of the unifying themes that made up our first school year at Cocoa Academy.

Identifying Available Resources

Before developing the Virtual Learning Activities that make up the thematic units, staff must determine the availability of important resources: time, people, knowledge, materials, equipment, and capital.

Time. Curriculum writers need to understand the parameters of the system in which the activities are to be implemented. Questions about block scheduling and the length of school terms must be considered as well as the amount of time required for students to meet the proposed integrated learning objectives.

People. It is important to consider who is available—and ready—to implement the activities. For example, what will the student-teacher ratios be? Besides instructional staff, will there be additional support staff, mentors, guest speakers, and/or volunteers to assist teachers with implementation of the Virtual Learning Activities?

Knowledge. Virtual Learning Activities require that students direct their own learning. Therefore, it is important to determine where students can turn to research the issues surrounding the problems they are given to solve. Some examples of knowledge sources include people, books, journals, CD-ROMs, and online services.

Materials. Identifying what materials will be available to students is critical to the curriculum writing, as it will often dictate the kind of learning situation they will encounter. For instance,

the problem-solving process for inventing a two-stage rocket is very different for students given prefabricated model parts compared with that of students offered only two party-balloons, a Styrofoam cup, a straw, and several paper clips. The feasibility of certain problem-solving activities also depends on the availability of materials. For example, the availability of photo-voltaic cells is an important consideration in the writing of a solar energy project.

Equipment. Everything from a simple pair of scissors to high-tech, computer-driven robotic arms may be considered equipment. Because all Virtual Learning Activities have a hands-on, design-and-build component, the type of equipment available to students is important. While it is necessary to maintain a technology-rich environment, cost factors will often dictate modifications and gradations of the term "technology-rich." Understanding the amount and kind of equipment available is essential to designing realistic problem-solving activities for students.

Capital. The bottom line, when defining resources, is generally capital. While it can contribute to or diminish the other resources, capital is also a factor to be considered in implementing Virtual Learning Activities. For example, some activities may require students to travel or to have start-up money for business ventures. If there is no capital available to students, then acquiring funding will become part of the students' problem-solving criteria; if capital resources are available, managing the capital will be the students' task.

Only when you have a clear picture of the resources available should you proceed with the writing of Virtual Learning Activities.

6

WRITING VIRTUAL LEARNING ACTIVITIES

Once we had laid the essential groundwork for an integrated curriculum (identifying learning objectives, developing a curriculum framework, and so on), we were ready to create Virtual Learning Activities. The first step in writing a VLA is to develop a "situation statement."

Choosing Real-World Situations

The situation statement in a Virtual Learning Activity is the real-world problem that students must solve. In creating the situation statement, four issues should be considered:

- *Relevancy.* The situation should be pertinent to the students' lives.
- *Realism.* Although VLAs can sometimes have hypothetical or futuristic "situations," they should be believable.
- *Explicitness.* If the students' are expected to solve the problem that the situation presents, then it must be described clearly and completely. Variables that the students must consider in order to solve the problem should be included in the situation statement.
- *Appropriateness.* The situation should align itself with the thematic unit and its measurable desired learning objectives.

The situation statement in Figure 6.1 takes into account all four of these criteria. It is relevant to the students' lives in that it

Figure 6.1
Student Page for Rocket-Building Activity

Situation Statement
You are student interns for NASA. As part of your internship, you must assist your mentors in developing a method for transporting payloads to a specific target area. A single-stage vehicle has been proven ineffective for this function.

Solution Statement
Design and build a multistage rocket propelled vehicle to go from a starting point to a target area in the shortest possible time. Test and modify your vehicle until optimal performance is met.

Design Brief
Criteria
- Brainstorm with team members.
- Design vehicle using Computer-Aided Design and Drafting software.
- Construct vehicle.
- Record steps taken in the vehicle construction process.
- Test vehicle and record your findings using spreadsheet software.
- Modify as needed to improve performance (any modifications to original design must be documented).
- Graph (simple bar) all time trials using spreadsheet software.
- Calculate average velocity for time trials.
- Document best time and modifications.
- Best run must be reproduced with similar results.
- Report the results of the brainstorming, building, and testing phases of the activity in a process-analysis essay.
- Have facilitator edit the rough draft of the essay before completing final draft.

Resources

Time:	4 hours
Energy:	Human
People:	Team
Knowledge:	Team members
Materials:	2 long party-balloons; 30 lb. test nylon monofilament fishing line; 2 plastic straws; Styrofoam coffee cup; masking tape; large paper clips; graph paper
Equipment:	Scissors; stop watches
Capital:	Not applicable

pertains to their internship work setting. It is believable, as it arose from a real problem that existed for NASA engineers. It is explicit in that it has delineated the variables that students are expected to consider in solving the problem. Finally, it is appropriate to the theme of the unit in which it was presented (Transportation). The activity described is designed to meet integrated, measurable desired learning objectives for the following subject areas: mathematics, language arts, technology education, economics, business, and science.

Developing Open-Ended Solution Statements

The next step in the VLA writing process is to challenge the student to solve the problem by developing a "solution statement." Solution statements frame the problem presented in the situation statement and direct students to "do" something in order to solve a problem. In creating the solution statement, the following three issues should be considered:

- The writer's primary concern should be to keep the solution open-ended. The solution statement should be framed in such a way that more than one correct answer or solution is possible.
- The solution statement should follow the problem-solving model (see Chapter 2).
- At least part of the solution must have a hands-on component.

The solution statement in Figure 6.1 conforms to these guidelines. Note that students are not given a set of procedures to follow, as in interdisciplinary projects that offer students a "follow-the-recipe" approach. Instead, the VLA solution statement presents a directive to which the student must respond creatively and critically in order to solve the problem. The solution is open-ended and learning takes place through discovery. The design, build, and test components of the solution follow the problem-solving model discussed in Chapter 2. Because students are not told how to do this activity, they will likely come up with a variety of solutions. Finally, this activity has a number of hands-on components.

Basing Criteria on Integrated, Measurable Desired Learning Objectives

Along with the solution statement, students must consider the "design brief." The design brief includes a list of resources and

criteria. In developing the design brief the curriculum writer should identify available resources and determine the integrated, measurable desired learning objectives to be met. A design brief must outline the resource parameters within which the students must work because in the real-world, there is always a finite amount of time, manpower, materials, equipment, and money with which to complete a job. Students must learn to work within these realistic constraints. The criteria section of the design brief guides students toward meeting their integrated, measurable desired learning objectives. Therefore, in developing the criteria, the learning objectives of the VLA should be considered. Figure 6.1 includes an example of a well-written design brief.

Measuring Performance Outcomes

The Content Connections Page of the Virtual Learning Activity lists the performance outcomes for the learning activity. Figure 6.2 on page 46, shows an example of the Content Connections Page for the rocket-building activity. It is easy to see both the repetitions and compatibilities of performance outcomes from subject to subject. Students achieve these performance outcomes by meeting the criteria listed in the design brief. Any one of the criteria may apply to several of the performance outcomes. For example, when students "test vehicle and record findings using spreadsheet software," they achieve these performance outcomes:

- Business—constructing tables and graphs
- Language Arts—gathering and documenting information, working in teams
- Mathematics—measuring time, collecting and organizing data, using formulas to solve problems, interpreting data, performing calculations
- Science—calculating velocity, speed, and distance
- Technology Education—using problem-solving and critical-thinking skills

Once these important components of the VLA have been put together by the teachers representing each of the academic and vocational/technical areas to be integrated, the curriculum writing team must then develop the methodology for instruction. Each subject-area teacher develops a Teacher Page for that subject area. The Teacher Page includes the measurable desired learning objectives to be met for a particular course, the methods and resources

Figure 6.2
Content Connections Page for Rocket-Building Activity

Business Computer Applications
Performing mathematical applications
Constructing tables and graphs
Preparing written analysis of charts and graphs

Language Arts
Gathering and documenting information
Working in teams (small-group discussion)
Writing expository essay (process-analysis essay)

Mathematics
Measuring time
Demonstrating problem-solving skills
Collecting and organizing data (graph)
Interpreting data
Using formulas to solve a problem
Performing basic calculations

Science
Calculating velocity, speed, and distance
Applying knowledge of compressed gases, action to action, friction, and inertia
Using scientific method to solve problems
Applying principles of Newton's Laws of motion and conservation of momentum for building the rocket

Technology Education
Applying design and problem-solving processes
Using problem-solving and critical-thinking skills
Using Computer Assisted Design and Drafting software to draw vehicle components

that will be used to achieve those objectives, and the methods by which the performance outcomes will be measured.

Figure 6.3 shows three examples of Teacher Pages for the rocket-staging activity developed earlier: one for language arts, one for a business course, and one for a science course. Note that in these examples, the Methodology and Resource sections are the same for each subject area with the exception of the introductory

Figure 6.3
Sample Teacher Pages for Rocket-Building Activity

Language Arts Teacher Page

Course: Writing I
Date:
Title: Rocket Staging

Measurable Desired Learning Objective
To use all stages of the writing process to write sentences, paragraphs, and multi-paragraph papers that are appropriate to the VLA design brief criteria.

Teacher Methodology and Activities
Review criteria for writing multi-paragraph papers
Conduct small group discussion
Begin VLA
Each division will reproduce its best run, with similar results, at least once
Each division will hold competitions.

References and Resources
Facilitators
Computers and software
Technology specialist
Science book
Fact sheet

Performance Outcome
Students may receive full credit for this activity by reporting the results of the VLA in a process-analysis essay which: uses standard written English and all stages of the writing process; and accurately documents the brainstorming, building, and testing procedures.

Business Technology Teacher Page

Course: Business Computer Applications I
Date:
Title: Rocket Staging

Measurable Desired Learning Objectives
To use mathematical applications and computer software that are appropriate to the VLA design brief criteria.

Teacher Methodology and Activities
Introduce use of spreadsheet application
Conduct small group discussion

(*continued*)

Figure 6.3—*continued*
Sample Teacher Pages for Rocket-Building Activity

Begin VLA
Each division will reproduce its best run, with similar results, at least once
Each division will hold competitions.

References And Resources
Facilitators
Computers and software
Technology specialist
Science book
Fact sheet

Performance Outcome
Students may receive full credit for this activity by using algebraic concepts and spreadsheets to interpret and display the information learned while fulfilling the VLA design brief criteria.

Science Teacher Page

Course: Principles Of Technology I
Date:
Title: Rocket Staging

Measurable Desired Learning Objectives
To determine the problems and the principles of force relating to mechanical systems that are appropriate to the VLA design brief criteria.

Teacher Methodology And Activities
Introduce equation and fact sheet on velocity and speed
Conduct small group discussion
Begin VLA
Each division will reproduce its best run, with similar results, at least once
Each division will hold competitions.

References And Resources
Facilitators
Computers and software
Technology specialist
Science book
Fact sheet

Performance Outcome
Students may receive full credit for this activity by satisfactorily solving the problems and understanding the principles of force required to fulfill the VLA design brief criteria.

activity. That instruction is devoted to a new subject-area skill and requires subject-area teachers to work with students in class-size groups. How much if this kind of instruction will be needed—and in which subject-areas—generally determines the complexity of the VLA. (Chapter 3 includes more information about teacher methodology.)

A Map for Teaching and Learning

Every Virtual Learning Activity gives teachers and students a road map for teaching and learning. The open-ended nature of the activities, however, allows students to take divergent paths in finding a solution—and sometimes to take the curriculum on an entirely different course than intended. That's when we know students and teachers both are really learning!

7

SUSTAINING THE NEW PROGRAM

The most difficult aspect of developing a break-the-mold program like Virtual Learning is not conceiving it but sustaining it. Although it's true that conceiving a unique and innovative program is a challenge, imagining is but a small piece of the struggle to reinvent a school. Only by building continuing support for a program can those involved help ensure its survival.

The real test for the Cocoa Academy came when external threats and internal weaknesses began to invade the fragile vision of a better learning place. Any school attempting to establish an innovative program for integrating academic and secondary curriculum will encounter similar roadblocks.

External Threats

Programs that diverge from the existing educational system will be under pressure to conform to the traditional mold. The greater the divergence, the greater the pressure. Because most truly innovative programs begin as pilot programs, they operate as a system within a system. This means that the pilot program has departed from what Spady (1995) calls the "major features of our educational system . . . , things like academic subject areas, grade levels, self-contained classrooms, nine month school years, and 'A' through 'F' grading. . . . Thinking, discourse, and policy making about education almost always start and end with these features." Therefore, programs that try to operate apart from what Spady

terms this "institutional inertia" will be under constant pressure to conform to the traditional mold.

These pressures can manifest themselves covertly in a number of ways. State and local statutes can thwart efforts to implement block scheduling and course modification. Block scheduling allows instructional staff the flexibility to implement an integrated curriculum, and course modification allows like standards across several disciplines to be met through activities in one course. Therefore, an important step in gaining support for a break-the-mold program is researching the statutes and obtaining any necessary waivers from state and local authorities.

Another major feature of the traditional school system that may pose an external threat to an innovative program is self-contained classrooms. This is an architectural problem that disallows team teaching and shared use of facilities. The threat can usually be overcome by persuading the school district to commit to providing the pilot program with an alternative instructional site that allows instructional flexibility. Waivers that allow credit to be earned off campus, in the community, or on the worksite may also be necessary. Either way, it is important to gain the support of key decision makers in both the district and the school; they must be convinced that breaking down the architectural and pedagogical barriers of contained classrooms is essential to the success of the program.

The nine-month school year can lead to the destruction of pilot programs that are closely aligned with community and industry efforts. For example, school-to-work transition programs that offer internship and apprenticeship opportunities cannot operate on a nine-month basis. Programs with regenerative curricula that require constant revision and improvement cannot afford to have an inactive instructional staff for three months. Programs in which students gain credit through community services and projects cannot simply shut down for a quarter of the year. These programs and others require year-round school and should create special agreements with their school district and local teacher unions.

Finally, one of the most debated and entrenched features of our educational system is the *A* through *F* grading system. Any program that attempts to contribute to school reform, will also have to look seriously at alternative forms of assessment and grading. As Alfie Kohn says, "grades cannot be justified on the grounds that they motivate students, because they actually under-

mine the sort of motivation that leads to excellence" (1993, p. 203). To build support for a program that will use alternative assessments and grading, a number of issues must be considered:

- Will local or state authorities require a waiver to change the existing grading system?
- If a waiver is requested, is the political climate of the community such that it will be granted?
- If a waiver is granted, will the alternative grading system of the innovative program cause students in the two systems to be treated inequitably? For example, will it inequitably affect the way students are ranked?

An important lesson we learned at CAAT is that support for an alternative assessment and grading system is best won if each of the above issues is resolved prior to implementation. Although it would have been possible for CAAT to acquire a waiver from state authorities for an alternative grading system, the local school district prevented us from obtaining it. Apparently, some members of the host school viewed CAAT's grading system as unfair to students outside of the career academy. That is, when it came to "rank-in-class," they believed that all students in the high school were not being measured with the same yardstick. Therefore, the political climate of the community was against the alternative grading system. Even after the issue of inequity was resolved, by providing separate ranking for CAAT students, the alternative grading system was still disallowed by the school district. As a result, while educators at CAAT do not adhere to the standard *A* through *F* system, they have had to modify the grading system they believe to be the best for students to accommodate that system. Had grading issues been addressed prior to implementation, the result may have been different.

Independent of the institutionalized features of our education system is an external threat that may be the most destructive to a new and still vulnerable break-the-mold program: the fear of change. In every school system, there are three types of people: those who are ready to jump on any bandwagon for change, those who sit on the fence until they have to change, and those who dig in their heels and never change. The first group represents the movers and shakers. They are the ones from whom it will be easiest to gain support for new and innovative programs. The second group will take their cue from the first, waiting to see the advantages or disadvantages of the change. The third and last group may

never be convinced to do things differently. They are sometimes referred to as rocks, because of their reluctance to move or be moved. Therefore, it is important to go around them carefully, because a collision with a rock can be a costly encounter. There are no easy answers for this last external threat to gaining support for an innovative program, but then change—any kind of change—is never easy, particularly in a system as stagnant as education.

Internal Weaknesses

Besides threats from the outside, break-the-mold programs can suffer weaknesses from within. Those involved in implementing the program must have a clear understanding of the vision supporting the program and believe in its worthiness. Lack of shared vision and a poor understanding of the new system and pedagogy are internal weaknesses that can keep a new program from being successful. At CAAT, we tried to safeguard the program against these weaknesses by ensuring that the program developers were also involved in implementation. As a result, during the crucial beginning months of the program there was a strong sense of shared decision making by all involved.

Lack of staff development can be an internal weakness. If the instructional staff are not prepared for the new challenges that the program presents, they and their students will not experience success. For example, as mentioned earlier, the implementation of Virtual Learning at CAAT requires that staff be experienced in cooperative learning, applied learning, team teaching, authentic assessment, and the facilitation of problem-posing learning. Had they not acquired those skills, CAAT teachers would have been ineffective and would have become frustrated in the Virtual Learning environment. Staff development must be part of the program planning.

Lack of leadership can also be an internal weakness to a growing program. Often there is no allocation of funds for a program coordinator—someone who can oversee many of the start-up, administrative, and organizational issues for which full-time instructional staff do not have the time. Instructional staff who try to fill the leadership gap may end up feeling overworked, overwhelmed, and, sometimes, at a loss for direction. At CAAT, we were fortunate to have grant funding to support a coordinator for the first three years of program implementation.

The inability of staff members to work as a team is a weakness in any organization. Start-up, break-the-mold programs will seri-

ously suffer if staff members are divided and unable to work together. For this reason, efforts were made early on in CAAT's planning to include team-building activities for staff.

Anticipating these threats and weaknesses, and working to turn them into opportunities and strengths is essential to the success of any break-the-mold program. Support for such a program comes from both within the program (instructional and support staff) and outside the program (school system, community, business and industry, parents, etc.). As we learned at CAAT, it is important to include all stakeholders in the planning and to make them part of the decision making.

The Roles of Business and Industry Partners

Business and industry can play an important part in the success of any program for integrating academic and vocational/technical education. There is a strong relationship between the Cocoa Academy for Aerospace Technology (CAAT) and its business and industry partners. Our relationship is symbiotic in that we meet each other's needs while fulfilling the educational goals of our learners.

Key features seven and nine in the Virtual Learning system speak to curriculum that is "real-world relevant" and resources that "mimic the workplace." To ensure the presence of these two features, we found that learning must extend past the classroom walls and into the workplace. At the same time, to ensure mutual understanding and shared vision, industry/business partners should have a presence in the classroom. Mutually advantageous relationships have grown and taken many roles.

- *Steering/advisory committee members.* By including members of the business community on our committees, we sent a clear message that we considered their knowledge and experience to be valuable components of our program. Many businesses also made various kinds of investments in the program.
- *Curriculum consultants.* Integrating academic and vocational/technical subject areas requires attention to relevancy. Business/industry partners helped our CAAT curriculum writers maintain relevancy while acting as advisors in their areas of expertise. Representatives from business and industry helped develop accurate performance outcomes and establish authentic assessments.
- *Technical consultants.* Computer specialists and industry/business partners with expertise in technical areas assisted

CAAT staff in making hardware, software, and equipment purchases. They also helped set up equipment and train staff to use it. Secondary schools should be particularly careful that their purchases meet industry standards.

- *Mentors.* One-to-one instruction can be very powerful in a young person's life. It is rare that students ever receive that kind of attention in the school setting. CAAT mentors provide the luxury of such instruction in our program. Mentors from local businesses and industry lend relevance to an already integrated activity. They can also assist students in making career choices.
- *Guest speakers.* Whenever possible, guest speakers should be invited to present in the classroom. They have helped CAAT instructional staff create the motivational hooks needed when introducing students to a particular unit or activity. For example, a unit on solar energy began with a visit to a solar energy center and ended with a guest speaker from the center. Students enjoyed the change of pace and the guest speaker lent credibility to the lesson.
- *Adjunct faculty.* Some businesses and industries will actually lend out an employee for a certain number of hours each week to act as an adjunct faculty member in a school. Adjunct faculty can take on whole classes or do individualized training. For example, an adjunct from one of our industry partners teaches Total Quality Management to a group of interested students at CAAT for college credit. Other adjuncts offer certification programs in specific technical fields. These kinds of partnerships can be invaluable and should be nurtured.
- *Worksite hosts for internships.* One of the most powerful experiences for students is a visit to an industry partner's worksite. Unpaid internship programs have afforded CAAT students an inside look at what their future may hold. Internships can be as simple as job shadowing or as complex as certification acquisition. Students not only learn about what jobs they would like to do, but also, and perhaps more important, what jobs they would not like to do. Internships are valuable to the integration process and further lend relevancy to the curriculum.
- *Apprenticeships.* Paid apprenticeships also provide valuable experiences for students, as they can develop into full-time jobs and eventual careers. Apprenticeships are usually formal agreements between schools and businesses in which details such as child-labor laws, workman's compensation, insurance, and union rules must be addressed.

• *Evaluators.* Business/industry partners can assist with program evaluation. As independent evaluators they can provide continuous feedback to the betterment of the program. CAAT has been very fortunate to have NASA as one of its industry evaluators.

The Roles of Education Partners

By expanding their skills and taking on new roles, educators—like businesspeople—can contribute to the continuing success of a program for integrating academic and vocational/technical education. Among their other new responsibilities, teachers at CAAT have taken on these new roles:

• *Interns/apprentices.* Just as it is important for students to have real-world work experiences, it is equally important for teachers to learn about today's workplace. Many teachers have never worked in any field except teaching. Their limited experiences can be detrimental to an integrated curriculum where relevancy is critical. Summer jobs and after-school apprenticeships for teachers have been very useful in helping CAAT teachers bring workplace relevancy to the classroom.

• *School-site hosts for business partners.* If the relationship between business/industry and the educational system is going to be truly mutual, then learning should also be mutual. Educators can provide their business/industry partners with a realistic look at classroom challenges. In a break-the-mold program, partners will learn that this school is very different from the school of their teenage years. Although business and industry have much to offer in the way of relevancy and expertise in their fields, they will probably need help with classroom management and pedagogy. CAAT has provided its business and industry partners with a new look at what the classroom of the 21st century can be.

The potential benefits for both the educational and business worlds become obvious when the members of each are considered stakeholders in learning. For the educational institutions, the benefits are reaped in fulfilling the goal of preparing learners to enter the workforce and to continue their education. The business world actualizes its advantage in a well-trained, well-educated, entry-level work force.

Aside from these overt pragmatic benefits for both the educational and business worlds, covert utopian advantages can be achieved from sharing in the responsibility for mutual learning. Just as educators understand the importance of articulation

between feeder grade levels, business and industry must also meet the challenges of working with the educational institutions from which it receives its most valuable resource—the future employee.

The Importance of Tailoring the Program to the Community

The Cocoa Academy for Aerospace Technology is one example of a program that has successfully implemented the Virtual Learning model for integrating academic and vocational/technical secondary curricula. The program exemplifies the classic career academy characteristics:

- school of choice
- school within a school
- career theme
- business-industry partnerships
- internships or apprenticeships
- relevant curriculum
- integration of vocational and academic curricula

The learning community of CAAT tailored Virtual Learning to meet its needs, structuring the program around the theme of aerospace technology. However, the program can be modified to meet the needs of any learning community. Answers to the following systems-related questions can assist in customizing a Virtual Learning program:

1. What is the aim of the program?
2. What is the operational definition of the program aim?
3. Who will the program serve?
4. What is the process of the program?
5. Who will provide feedback for process improvement?
6. What will the program produce?
7. Who will provide feedback for product improvement?
8. Upon what theoretical premises does the program rely?

The following are CAAT's responses to those questions:

1. The Aim of the Academy is to prepare students to enter aerospace or other high-tech employment and to continue their education.

2. The operational definition of the aim is that students will achieve (a) SCANS competencies and foundations, (b) postsecondary enrollment, and (c) job placement (high-tech).

3. The program will serve students and their parents, industry, the community, and postsecondary educational institutions.

4. The process of the Academy is to facilitate learning.

5. The Voice of the process is represented by the Academy's students, parents, and partners. They report on what is working and what is not.

6. The product of the Academy is the student.

7. The Voice of the product is represented by industry, postsecondary educational institutions, and the community.

8. The theoretical premises of the program are: relevancy, cooperative learning, ownership, accountability, continuous improvement, customized learning, and integration across the curricula and between grade levels.

8

"ALL THE CHILDREN OF ALL THE PEOPLE"

> We can never educate all the children of all the people till we change our inherited thought as to what an education will do for a child. As things are now, there is one idea that is most prominent in the general mind on this score, and it is one of the ideas that it will be exceedingly difficult to get rid of because it is so generally diffused among our people. It is the notion that if a child gets a good memory-knowledge of books he will thereby be relieved from the necessity of working with his hands, and that to work with one's hands is disgraceful (Smith 1912, p. 169).

As you embark on creating a new curriculum—one that includes all that is good in both academic and vocational education—you will want to heed Smith's warning that changing the public's negative opinion about working with one's hands will be "difficult to get rid of." In fact, nearly a century after he wrote this, vocational (hands-on) education is still considered second-class in American education. Although Smith wrote *All the Children of All the People* at the turn of the century, you will surely encounter the classist attitude that he describes as you attempt to implement a program that includes a strong hands-on, applied component.

A theory to remember while trying to come to consensus with your stakeholders about what it will take to produce "educated" graduates is one that Smith uses in his historical account of

American education. He convinces the reader that all children possess strengths and weaknesses. He compares these inherent strengths and weaknesses to being "born short" and being "born tall." The implication is that learning differences are simply that, differences that are as arbitrary and nonindicative of intelligence as height. A more contemporary educational researcher, Howard Gardner (1983), whose work in the area of multiple intelligences has had a significant influence on the way we perceive intelligence, supports the same theory. Gardner proposes that every person has seven areas of intelligence (linguistic, logical-mathematical, spatial, bodily-kinesthetic, musical, interpersonal, and intrapersonal), and that the degree of intelligence in each area varies from person to person. The work of Gardner and others who have researched the theory of multiple intelligences has contributed to three widely accepted assumptions about learning:

- All children can learn.
- All children possess a variety of strengths and weaknesses.
- All children learn differently.

These three assumptions should underscore your attempts to build support for your new curriculum and its supporting Virtual Learning system.

At the turn of the century, Smith pointed out that although "all of the people" were taxed for the education of all the nation's children, "all of the children" were not graduating. In fact he doubted that even "ten percent of the enrollment of their entering classes in the primary rooms" would graduate (p. 129). He blamed the poor graduation rate on "the failure of the founders of the public school system to realize the natures and kinds of material they had to deal with in their undertaking." In fact, he believed that "fundamental elements, in all children, were denied and ignored, almost absolutely, in the original fashioning of our public school system" (p. 140)—a system that "intended to make book-learned men—clergymen, doctors, lawyers, teachers, and to give scholarly adornment to the sons of gentlemen who had money enough so that they would never have to earn anything more, surely not by the work of their own hands" (p. 141). Why then, if only ten percent of the population were "educated" should the tax burden for their education fall on "all the people"?

As we approach the next century, little has changed. Although we know a lot more about the way students learn and we have manipulated the system to improve the graduation rate, we are

still teaching to one kind of learner—the one following a college-prep track. The unfortunate truth is that, although all the people pay, all the children are not learning. If being educated is, as Smith defines, a person who is "onto his job" (one who is competent in his or her chosen occupation), then all children are certainly not being educated. We have only to listen to industry and the post-secondary schools to know that we are not preparing high school students for the challenges of our times. Students are not receiving the broad-based education needed to acquire the competencies and foundations upon which our economic and social survival depend (see U.S. Department of Labor 1991).

That we still believe "the whole education of all the children, from entrance day to graduation, should be fashioned with a classical college education as the ultimate goal to be reached by all the children of all the people" (p. 115) is the heart of our problem; and that we insist on separating academic from vocational education compounds it. There should be no division between academic and vocational education, as they are both needed for the education of "all the children of all the people." Therefore, the integration of academic and vocational curricula is central to democracy in public schools. In fact, by segregating academic and vocational education, we are insuring segregation by labeling children as "those who can" and "those who can't."

At the end of *All the Children of All the People* Smith rhetorically asks, "Will we be genuinely democratic in this nation we so proudly call the land of the free; or will we be aristocratic and monarchical in fact, while sitting under the protection of the Stars and Stripes?" (p. 334). Idealistically and in response to his own question, he predicts that "our people will, one day, put our public schools into such shape that they will do all that is required of them; that they will take into account the way the children are, each one of them, and that they will so teach, train, and educate them, that they will, each one, fill to the full the particular niche in our Republic which his or her own individuality is best fitted for" (p. 335).

Nearly one hundred years later, we are still trying to reconcile the differences and inequalities of academic and vocational curricula, not because of their dissimilarities but because of what they represent. As you develop your program for the seamless integration of academic and vocational/technical secondary curricula, consider your learning community's "inherited thought as to what an education will do for a child" (p. 169). Your program's success

in serving "all the children of all the people" will depend on disarming the elitist prejudices that have nurtured the inequalities and separateness of academic and vocational education over the years.

BIBLIOGRAPHY

Bailey, A. (September/October 1991). "Integration vs. Correlation." *Ties to Teaching*, pp. 36–39.

Betts, F. (April 1994). "On the Communication Age: A Conversation with David Thornburg." *Educational Leadership* 51, 7: 20–23.

Blank, W.E., and J.B. Scaglione. (1992). *Integrating Academic and Vocational Education Implementation Guide*. Tallahassee: Florida Department of Education.

Clark, B. (Winter 1988). "Integrative Education." *In Context* 18: 44–47.

Collins, A., J. Brown, and A. Holum. (Winter 1991). "Cognitive Apprenticeship: Making Thinking Visible. *American Educator*, pp. 6–46.

Dagget, W.R. (1995). *Testing and Assessment in American Schools—Committing to Rigor and Relevance*. Schenectady, New York: International Center for Leadership in Education.

Deming, W.E. (1986). *Out of the Crisis*. Cambridge: MIT Center for Advanced Engineering Study.

Dubois, J. (October 1995). "The Great Facilitator." *Internet*, pp. 62–68.

Emerson, R.W. (1926). *Emerson's Essays*. New York: Thomas Y. Crowell.

Flower, L. (1988). *The Role of Task Representation in Reading-to-write: Exploring a Cognitive and Social Process*. Series, Tech. Rep. No. 2.

Fogarty, R. (October 1991). "Ten Ways to Integrate Curriculum." *Educational Leadership* 48, 2: 61–65.

Freire, P. (1970). *Pedagogy of the Oppressed*. New York: Continuum.

Gardner, H. (1983). *Frames of the Mind: The Theory of Multiple Intelligences*. New York: Basic Books.

Grubb, W.N. (1991). *"The Cunning Hand, the Cultured Mind": Models for Integrating Vocational and Academic Education*. Berkeley: National Center for the Research in Vocational Education, University of California at Berkeley.

Grubb, W.N. (1995). *Integration Through Occupations in American Schools, Volume 1: Approaches to Integrating Academic and Vocational Education*. New York: Teachers College Press.

Harris, L. (October 1991) "An Assessment of American Education." *The Polling Report* 7, 20: 1, 8.

Hughs, M., and F. Betts. (1991). Curriculum Integration in the Primary Grades: A Framework for Excellence. *ASCD Curriculum Handbook*. Alexandria, Va.: ASCD.

Jacobs, H.J. (Fall 1989). "Interdisciplinary Curriculum Options: A Case for Multiple Configurations." *Educational Horizons*, pp. 25–35.

Johnson, D., and R. Johnson. (1988). *Cooperation in the Classroom*. Edina, Mo.: Interaction Book Company.

Johnson, D. (1987). *Human Relations and Your Career*. 2nd ed. Englewood Cliffs, N.J.: Prentice Hall.

Kemple, J.K., and J.L. Rock. (1996). *Career Academies*. New York: Manpower Demonstration Research Corporation.

Kohn, A. (1993). *Punished by Rewards*. New York: Houghton Mifflin.

Kovalic, S. (Summer 1989). "Brain Compatible Learning and Integrated, Thematic Instruction." Notes from a professional development institute in the Village of Oak Creek, Arizona.

McCune, S. (1986) *Guide to Strategic Planning for Educators*. Alexandria, Va.: ASCD.

Mann, J. (October 30, 1991). "Ahead: Workplace Flexibility." *The Washington Post*, p. B3.

Mishel, L., and R. Teixeira. (October 1991). "Talk of Coming Labor Shortage Is Just Fiction." *Roll Call*, p. 8.

"Preparing Young People for the Workforce." (July 2, 1991). *USA Today*.

Rosenstock, L. (February 1991). "The Walls Come Down: The Overdue Reunification of Vocational and Academic Education. *Phi Delta Kappan*, pp. 434–436.

Smith, H.W. (1912). *All the Children of All the People*. New York: Macmillan.

Spady, W.G. (September 1995). "We Need More Educentric Standards." *Educational Leadership* 52, 1: 82–86.

U.S. Department of Labor. (1991). *What Work Requires of Schools A SCANS Report for America 2000*. Washington, D.C.: Secretary's Commission on Achieving Necessary Skills, U.S. Department of Labor.

Vobejda, B. (January 21, 1988). "Life Without College Diploma Gets Harder." *The Washington Post*, p. H2.

Warwick, R., (1992). *Transforming Education: A New Philosophy*. Evanston, Ill.: National-Louis University.

Welsman, J. (October 1991). "Few Businesses Bolster Training Programs to Make Up For School Shortfalls, Poll Finds." *Education Week*, p. 5.

Whitman, D. (June 1989). "The Forgotten Half." *U.S. News and World Report*, pp. 45–53.

GLOSSARY

Applied learning A learning system which requires that students apply acquired knowledge. Applied learning (a) involves all of the modalities: visual, auditory, kinesthetic, and tactual; (b) requires students to apply specific concepts by "doing" real-world activities; and (c) requires students to demonstrate real-world social skills in their learning process.

Architectural barriers Any obstacle presented by the physical-plant that prevents instructional flexibility. The self-contained classroom is an example of an architectural barrier.

Authentic assessment Evaluating a skill or knowledge in a way that is connected and relevant to the application of that skill or knowledge.

Authentic integration An integration model without curricular, architectural, scheduling, or instructional barriers.

Banking education An instructional strategy whereby the teacher deposits information into the minds of the students, and the students patiently receive, memorize, and repeat the information back to the teacher.

Break-the-mold program An educational program that departs from the traditional system.

CAAT *See* Cocoa Academy for Aerospace Technology.

Carnegie units Points awarded for the number of hours a student spends in each class.

Cocoa Academy for Aerospace Technology (CAAT) A school-to-work transition program for students in grades 10 thru 12 characterized by (1) its commitment to high standards and unique approach to integrating academic and vocational learning; (2) its success in using relevancy to motivate students to "stay in school"; (3) its pledge to link work and learning by nurturing partnerships with the aerospace industry; (4) its use of hands-on technology to improve students' prospects for employment that will lead to a career; (5) its simulation of the corporate workplace through the use of industry-standard hardware and software tools. CAAT is more like a research and development lab than a traditional classroom.

Content connections The links between subject areas that can be addressed and reinforced in a learning activity.

Continuous quality improvement A system for improving economic production. First introduced by W. Edwards Deming in Japan in 1950, this system has had a worldwide impact on quality management in a variety of systems, including education.

Cooperative learning The process of working together in an environment where students learn from one another. It requires students to demonstrate positive interdependence, individual accountability, interpersonal and small-group skills, and processing or self-evaluation.

Curriculum barriers Anything that prevents the implementation of an integrated, problem-solving activities curriculum.

Design brief The part of a problem-solving activity that delineates (a) the constraints around which students must work, (b) the standards they must meet, and (c) the real-world resources that students will have at their disposal: time, energy, people, knowledge, materials, capital, tools, and equipment.

Desired learning objectives The reasons for learning to take place.

Discipline-based curriculum A curriculum in which there are no attempts to integrate content areas.

Educentric standards Standards that serve only the existing educational system—not the student.

External threats Obstructions erected by the traditional educational system to maintain the status quo.

Framework An existing set of mandated educational performance standards established by state or local school districts.

Hands-on learning An applied learning strategy that involves relevancy and, therefore, motivates students by engaging them psychologically, physically, socially, and emotionally.

Institutional inertia The indolence of a traditional educational system, the result of being wedded to academic subject areas, grade levels, self-contained classrooms, nine-month school years, and A through F grading systems.

Inauthentic assessment Evaluating a skill or knowledge in a way that is not connected or relevant to the application of that skill or knowledge.

Instructional barriers Anything that prevents the instructional delivery of cooperative learning, thematic instruction, the problem-posing concept, team teaching, or authentic assessment.

Instructional flexibility Using a variety of teaching strategies to achieve desired learning objectives.

Integrated curriculum The integration of course content across disciplines.

Integrated learning Instead of curriculum developers looking at learning objectives for individual courses to create a scope and sequence, they may deal with the connected areas of study (by virtue of their sameness and/or positive interdependence) as they would a single-subject curriculum.

Interdisciplinary units Units developed around a central theme and involving a full range of disciplines.

Internal weaknesses Elements within a system that can conspire to destroy it. Examples are: poor or inadequate leadership, lack of shared vision, and inadequate resources.

Learning community All stakeholders in the educational system: students, teachers, administrators, district personnel, parents, business community, and so on.

Low-level integration Curriculum integration that occurs without attempts at systemic change. For instance: academic teachers trying to include more applied learning in their subject area, and vocational teachers trying to include academic concepts in their lessons.

Manpower Demonstration Research Corporation (MDRC) A nonprofit research organization specializing in evaluating the impact of social-service, welfare and education programs. MDRC is conducting a national longitudinal study of career academies in which CAAT is one of ten.

Mastery Students meet their subject-area learning objectives in the process of completing their learning activities/projects. Students must achieve 100% "mastery," as defined in the VLA design brief, in order to receive a grade.

MDRC *See* Manpower Demonstration Research Corporation.

Open-ended problem A problem that has more than one solution.

Paradigm A pattern, example, or model.

Performance outcome The results of learning. In a Virtual Learning Activity, performance outcomes are authentically assessed to determine whether learning has taken place.

Problem-solving paradigm An essential ingredient to curricular integration, as it requires the participant to think critically, creatively, and resourcefully while employing basic academic, technical, and social skills. The problem-solving steps are: (1) Identify the problem. (2) Research the problem. (3) Define available resources. (4) Explore ideas. (5) Plan/design. (6) Create/build. (7) Test. (8) Revise.

Problem posing A dialectic method of education where the teacher is no longer merely the-one-who-teaches, but one who is himself taught in dialogue with the students, who in turn, while being taught, also teach.

Real learning Knowledge acquired in the natural world, where the consequences of inadequate mastery are determined by the laws of nature.

Real world Existing or happening in fact, not imaginary. The space surrounding the educational system where students will be required to apply what they have learned.

SCANS report Shorthand for *What Work Requires of Schools: A SCANS Report for America 2000*, a report issued in 1991 by the Secretary's Commission on Achieving Necessary Skills, U.S. Labor Department. This report examines the demands of the workplace and whether young people are capable of meeting those demands by (a) defining the skills needed for employment, (b) proposing acceptable levels of proficiency, and (c) developing a dissemination strategy for the nation's schools, businesses, and homes.

School-within-a-school Small subsystems that usually have a career theme and operate as part of a comprehensive high school. They are often independent of the traditional educational system in terms of curriculum, scheduling, discipline, attendance requirements, etc., and offer the learning community the freedom and flexibility to create a learning environment that meets their needs.

Scope and sequence The depth, breadth, and continuity of curricular content and desired learning objectives.

Seamlessly integrated curriculum All of the course content brought together into a whole that is greater than the sum of its parts. It provides (a) a learning-to-learn situation, (b) a vehicle for integrating vocational/technical and core academic concepts, (c) a simulation for workplace know-how or what work requires of schools, and (d) a need for creative thinking and problem solving.

Situation statement In a Virtual Learning Activity, this is the real-world problem that the student must solve.

Systemic change Making widespread modifications to the existing educational system, including altering major features such as separate academic and vocational subjects, Carnegie units, scheduling, assessing and grading, the nine-month year, etc.

Talmud The collection of writings constituting the Jewish civil and religious law.

Team teaching Teacher collaboration that includes partnerships for developing curriculum, delivering instruction, assessing teaching and learning, and sharing facilities.

Technology education The study of the application of knowledge, creativity, and resources to solve problems and extend human potential.

Technology A large topic that means many things to many people. In this book, technology is the system whereby a society satisfies the needs and desires of its members. People began using technology when they invented the first tool.

Technology learning activities (TLAs) Based on the traditional technological design and problem-solving process used in engineering and science, TLAs have their origin in the discipline of technology education, where they have been used by K-12 programs to incorporate biotechnology, information technologies, and physical technologies in promoting the integration of academic and career skills.

Thematic instruction Curriculum coordination or correlation in which students are given assignments, projects, or activities that revolve around a big idea or central theme in each of their subject-area classes.

TLA *See* Technology Learning Activities.

Unit themes "Big ideas" or concepts that encompass an integrated course framework. An example of a unit theme is "Energy."

Virtual Learning A model for seamlessly integrating vocational and academic curricula that requires systemic change. It is founded on the belief that all children can learn and provides the opportunity and stimulus for students to direct their own learning in a technology-rich environment.

Virtual Learning Activities (VLAs) Hands-on problem-solving activities built on the technological problem-solving paradigm. VLAs are modeled after Technology Learning Activities. The principle difference between VLAs and TLAs is their scope. VLAs are designed to address a comprehensive academic program that includes all the core academic areas and specific vocational/technical, career disciplines; TLAs are more contained. VLAs and Virtual Learning replace the traditional separation of vocational and academic education.

VLA *See* Virtual Learning Activities.

Workplace know-how Term used in the SCANS report to mean effective job performance. This know-how has two elements, Competencies and Foundations.

Worksite learning Learning that occurs in the workplace, either through mentorships, internships, or youth apprenticeships.

ABOUT THE AUTHORS

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For the last six years Penn has been employed by the School Board of Brevard County, developing school-to-work transition programs. The Cocoa Academy and its Virtual Learning model of seamlessly integrating academic and vocational education is an outgrowth of her work with the Brevard County School District as well as her doctoral research.

Born in New York City, Penn attended Hunter College of the City University of New York for both undergraduate and graduate work. Her classroom experience includes 14 years of teaching adolescents and young adults; her work in curriculum and staff development over the past six years has taken Penn to the Bahamas and all over the United States. She is a doctor of education (Nova University) with a specialty in management of programs. Her doctoral research focused on integrated curriculum and school reform. She lives in Melbourne, Florida, with her husband and two children.

Dennis Williams has been a business partner of the Cocoa Academy for Aerospace Technology and has been responsible for its network design and implementation. Along with his technical assistance to the Cocoa Academy, Williams has consulted with the staff on matters of curriculum relevancy, performance standards, and authentic assessment.

Williams brought a wealth of industry expertise to the Cocoa Academy as a result of his experiences as an engineer on the Apollo Lunar Landing Program and as an Information Systems Manager for Walt Disney Imagineering. His unique teaching background includes 10,000 hours of flight instruction, 20 years of teaching aviation ground school, and 15 years as a certified scuba and cave diving instructor.

About ASCD

Founded in 1943, the Association for Supervision and Curriculum Development is a nonpartisan, nonprofit education association, with international headquarters in Alexandria, Virginia. ASCD's mission statement: *ASCD, a diverse, international community of educators, forging covenants in teaching and learning for the success of all learners.*

Membership in ASCD includes a subscription to the award-winning journal *Educational Leadership*; two newsletters, *Education Update* and *Curriculum Update*; and other products and services. ASCD sponsors affiliate organizations in many states and international locations; participates in collaborations and networks; holds conferences, institutes, and training programs; produces publications in a variety of media; sponsors recognition and awards programs; and provides research information on education issues.

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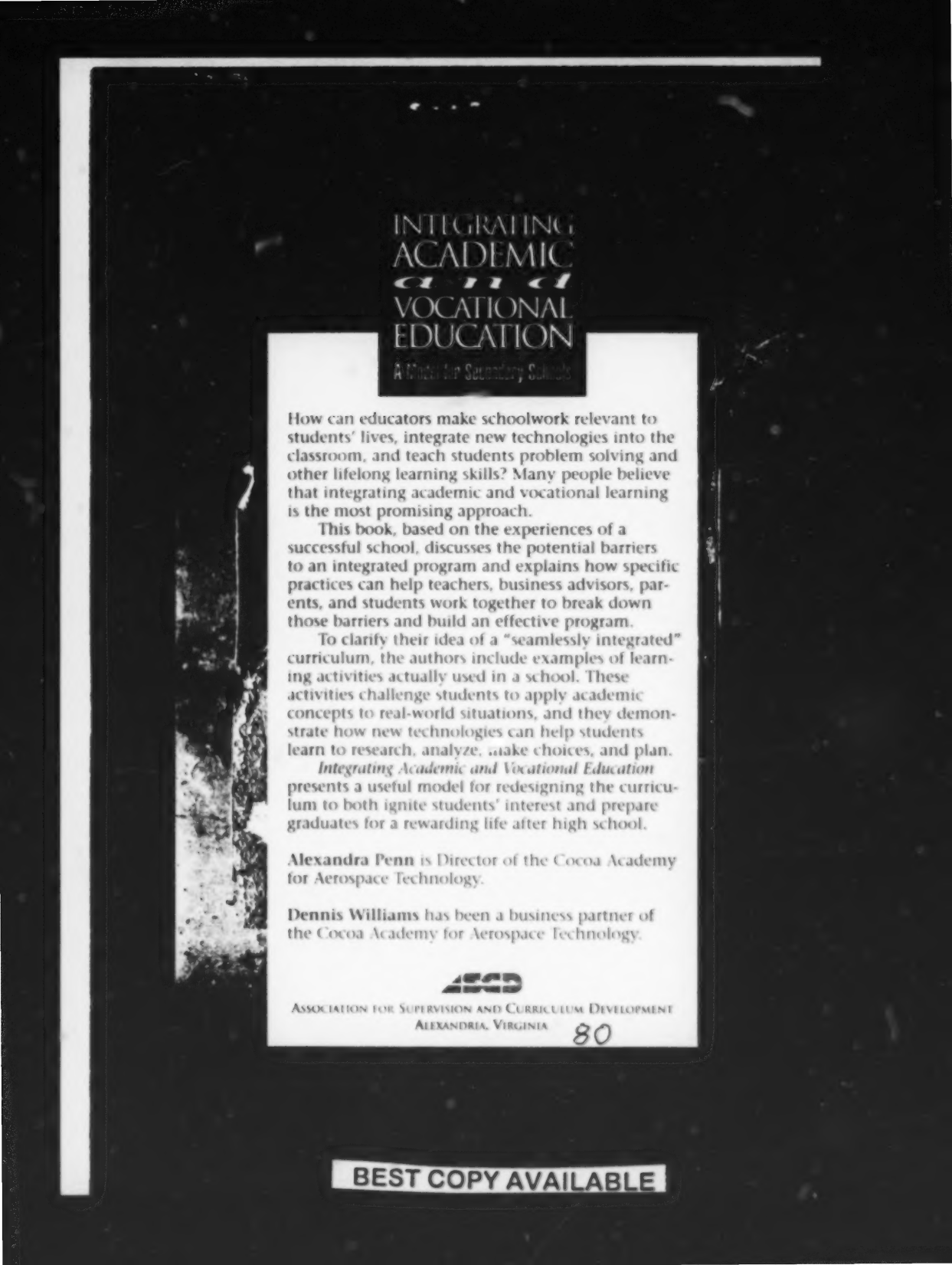

How can educators make schoolwork relevant to students' lives, integrate new technologies into the classroom, and teach students problem solving and other lifelong learning skills? Many people believe that integrating academic and vocational learning is the most promising approach.

This book, based on the experiences of a successful school, discusses the potential barriers to an integrated program and explains how specific practices can help teachers, business advisors, parents, and students work together to break down those barriers and build an effective program.

To clarify their idea of a "seamlessly integrated" curriculum, the authors include examples of learning activities actually used in a school. These activities challenge students to apply academic concepts to real-world situations, and they demonstrate how new technologies can help students learn to research, analyze, make choices, and plan.

Integrating Academic and Vocational Education presents a useful model for redesigning the curriculum to both ignite students' interest and prepare graduates for a rewarding life after high school.

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